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No. 2,452.] *FRIDAY, NOVEMBER 17, 1899.* *[Vol. XLVIII.*

ONE-HUNDRED-AND-FORTY-SIXTH SESSION, 1899-1900.

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-Hundred-and-Forty-Sixth Session was held on Wednesday evening, the 15th of November, when an Address by SIR JOHN WOLFE BARRY, K.C.B., F.R.S., Chairman of the Council, was read.

Wednesday evenings, at 8 o'clock :—

The following arrangements have been made for the meetings before Christmas :—

NOVEMBER 22.—D. E. HUTCHINS, Conservator of Forests, Cape Town, "National Forestry." GENERAL MICHAEL, C.S.I., will preside.

[In Mr. Hutchins's absence at the Cape, Prof. W. R. Fisher, of Cooper's-hill, has kindly consented to read the paper on his behalf.]

" 29.—ALLAN WYON, "The Great Seals of England." RICHARD R. HOLMES, M.V.C., F.S.A., Librarian to the Queen, will preside.

DECEMBER 6.—JOSEPH CASH, "Artificial Silk." SIR THOMAS WARDLE will preside.

" 13.—F. G. AFLALO, "Sea Angling and Legislation."

" 20.—H. BLOOMFIELD BARE, F.R.I.B.A., "Bi-Manual Training by Blackboard Drawing." WALTER CRANE will preside.

Papers for meetings after Christmas :—

CHARLES H. GADSBY, "Electric Traction."

JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E., "Steam Motors for Common Roads."

PROFESSOR R. W. WOOD, "The Diffraction Process of Colour Photography."

PROFESSOR W. BOYD DAWKINS, M.A., F.R.S., "Coal in South-Eastern England."

PROFESSOR W. M. FLINDERS PETRIE, D.C.L., "A National Repository of Science and Art.'

PROFESSOR CHARLES A. CARUS-WILSON, M.A., "The Electrical Induction Motor on Mountain Railways."

ARTHUR RIGG, "Ventilation without Draughts."

SIR MARTIN CONWAY, "The Undeveloped Resources of the Bolivian Andes."

W. H. WARD, "The Orloff Process of Colour Printing."

H. MACAN, "Continuation School Work in Rural Districts."

EDWIN BALE, "Artistic Copyright."

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons, at 4.30 o'clock :—

December 14, January 18, February 8, March 8, April 26, May 17.

DECEMBER 14, at 4.30 o'clock.—COLONEL R. C. TEMPLE, C.I.E., "Round about the Andamans and Nicobars."

SIR WILLIAM LEE-WARNER, K.C.S.I., M.A., "Our Work in India in the 19th Century."

J. A. BAINES, C.S.I., "The Industrial Development of India."

J. M. MACLEAN, M.P., "New Projects of Railway Communication with India."

SIR JOHN SCOTT, K.C.M.G., D.C.L., "Indian and English Criminal Procedure."

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on Tuesday afternoons, at 4.30 o'clock :—

November 23, February 1, 27, March 20.

NOVEMBER 23, THURSDAY at 4 30 o'clock.—JOHN FERGUSON, "Old and New Colombo." SIR THOMAS SUTHERLAND, G.C.M.G., LL.D., M.P., will preside.

FEBRUARY 1.—The Right Hon. SIR CHARLES DILKE, Bart., M.P., "The Century in our Colonies."

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday Evenings, at 8 o'clock :—

January 30, February 13, March 13, April 3, May 8, 29

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday Evenings, at 8 o'clock :—

HENRY HARDINGE CUNYNGHAME, "Art Enamelling upon Metals." Four Lectures.

LECTURE I.—NOVEMBER 20.—What enamel is—Various styles of enamelling—Cloissoné—Champlevé—Mediæval art—The Renaissance—Limoges enamels—Choice of a style in enamelling.

LECTURE II.—NOVEMBER 27.—Method of executing Limoges enamels—Preparation of the metal plate, of the enamels—The firing paillons.

LECTURE III.—DECEMBER 4.—The method of making enamels—Fluxes—The metallic oxides.

LECTURE IV.—DECEMBER 11.—The application of enamel to jewellery—Gold working—Gilding.

BENNETT H. BROUGH, "Metalliferous Deposits." Four Lectures.
January 22, 29, February 5, 12.

E. SANGER SHEPHERD, "The Photography of Colour." Four Lectures.
March 5, 12, 19, 26.

MAJOR PHILIP CARDEW, R.E., "The Control, Regulation and Measurement of the Supply of Electrical Energy." Three Lectures.
May 7, 14, 21.

JUVENILE LECTURES.

Two Lectures suitable for a juvenile audience will be delivered on Wednesday Evenings, January 3 and 10, at Seven o'clock, by HERBERT JACKSON, M.A., on "The Phenomena of Phosphorescence."

CONVERSAZIONE.

The Annual Conversazione of the Society will probably be held on Wednesday, June 20. Each member will receive a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, of Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department or science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session, three of which during the Session 1898-9 will be at the Imperial Institute.

FOREIGN AND COLONIAL SECTION.—This Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies, and with Foreign Countries. Four Meetings will be held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

Cantor Lectures.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists generally of two or more Lectures.

Additional Lectures.—Special Courses of Lectures are occasionally given.

Juvenile Lectures.—A Short Course of Lectures, suited for a Juvenile audience is delivered to the Children of Members during the Christmas Holidays.

Admission to Meetings.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

Journal of the Society of Arts.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

Examinations.—Examinations, founded in 1853, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal divisions of a Commercial Education, Domestic Economy, and Music. A Programme, containing detailed information about the Examinations, can be had on application to the Secretary.

Library and Reading-room.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

Conversazioni are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present between three and four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid.

Every Member whose subscription is not in arrear is entitled :—

To be present at the Evening Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him at the Society's House, John-street, Adelphi, London, W.C.

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1899-1900. It is issued subject to any necessary alterations:—

NOVEMBER, 1899.

1	W	
2	Th	
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	Ordinary Meeting
16	Th	(Opening Meeting
17	F	of the Session)
18	S	
19	**S**	
20	M	Cantor Lecture I. 1
21	Tu	
22	W	Ordinary Meeting
23	Th	For. & Col. Section
24	F	
25	S	
26	**S**	
27	M	Cantor Lecture I. 2
28	Tu	
29	W	Ordinary Meeting
30	Th	

DECEMBER, 1899.

1	F	
2	S	
3	**S**	
4	M	Cantor Lectur I. 3
5	Tu	
6	W	Ordinary Meeting
7	Th	
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture I. 4
12	Tu	
13	W	Ordinary Meeting
14	Th	Indian Section
15	F	
16	S	
17	**S**	
18	M	
19	Tu	
20	W	
21	Th	
22	F	
23	S	
24	**S**	
25	M	Christmas Day
26	Tu	*Bank Holiday*
27	W	
28	Th	
29	F	
30	S	
31	**S**	

JANUARY, 1900.

1	M	
2	Tu	
3	W	Juvenile Lecture I.
4	Th	
5	F	
6	S	
7	**S**	
8	M	
9	Tu	
10	W	Juvenile Lecture II.
11	Th	
12	F	
13	S	
14	**S**	
15	M	
16	Tu	
17	W	Ordinary Meeting
18	Th	Indian Section
19	F	
20	S	
21	**S**	
22	M	Cantor Lecture II. 1
23	Tu	
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	**S**	
29	M	Cantor Lecture II. 2
30	Tu	Applied Art Section
31	W	Ordinary Meeting

FEBRUARY, 1900.

1	Th	For. & Col. Section
2	F	
3	S	
4	**S**	
5	M	Cantor Lecture II. 3
6	Tu	
7	W	Ordinary Meeting
8	Th	Indian Section
9	F	
10	S	
11	**S**	
12	M	Cantor Lecture II. 4
13	Tu	Applied Art Section
14	W	Ordinary Meeting
15	Th	
16	F	
17	S	
18	**S**	
19	M	
20	Tu	
21	W	Ordinary Meeting
22	Th	
23	F	
24	S	
25	**S**	
26	M	
27	Tu	For. & Col. Section
28	W	Ordinary Meeting

MARCH, 1900.

1	Th	
2	F	
3	S	
4	**S**	
5	M	Cantor Lecture III. 1
6	Tu	
7	W	Ordinary Meeting
8	Th	Indian Section
9	F	
10	S	
11	**S**	
12	M	Cantor Lecture III. 2
13	Tu	Applied Art Section
14	W	Ordinary Meeting
15	Th	
16	F	
17	S	
18	**S**	
19	M	Cantor Lecture III. 3
20	Tu	For. & Col. Section
21	W	Ordinary Meeting
22	Th	
23	F	
24	S	
25	**S**	
26	M	Cantor Lecture III. 4
27	Tu	
28	W	Ordinary Meeting
29	Th	
30	F	
31	S	

APRIL, 1900.

1	**S**	
2	M	
3	Tu	Applied Art Section
4	W	Ordinary Meeting
5	Th	
6	F	
7	S	
8	**S**	
9	M	
10	Tu	
11	W	
12	Th	
13	F	Good Friday
14	S	
15	**S**	Easter Sunday
16	M	*Bank Holiday*
17	Tu	
18	W	
19	Th	
20	F	
21	S	
22	**S**	
23	M	
24	Tu	
25	W	Ordinary Meeting
26	Th	Indian Section
27	F	
28	S	
29	**S**	
30	M	

MAY, 1900.

1	Tu	
2	W	Ordinary Meeting
3	Th	
4	F	
5	S	
6	**S**	
7	M	Cantor Lecture IV. 1
8	Tu	Applied Art Section
9	W	Ordinary Meeting
10	Th	
11	F	
12	S	
13	**S**	
14	M	Cantor Lecture IV. 2
15	Tu	
16	W	Ordinary Meeting
17	Th	Indian Section
18	F	
19	S	
20	**S**	
21	M	Cantor Lecture IV. 3
22	Tu	
23	W	Ordinary Meeting
24	Th	
25	F	
26	S	
27	**S**	
28	M	
29	Tu	Applied Art Section
30	W	Ordinary Meeting
31	Th	

JUNE, 1900.

1	F	
2	S	
3	**S**	Whit Sunday
4	M	*Bank Holiday*
5	Tu	
6	W	
7	Th	
8	F	
9	S	
10	**S**	
11	M	
12	Tu	
13	W	
14	Th	
15	F	
16	S	
17	**S**	
18	M	
19	Tu	
20	W	Conversazione
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	Annual General
28	Th	Meeting
29	F	
30	S	

The Chair will be taken at Eight o'clock at each of the Ordinary Meetings, the Cantor Lectures, and the Meetings of the Applied Art Section.

The Meetings of the Indian Section and the Foreign and Colonial Section will commence at Half-past Four.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Seven o'clock.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

A meeting of the Committee of the Foreign and Colonial Section was held Tuesday afternoon, 15th inst. Present:—Sir Charles Malcolm Kennedy, K.C.M.G., C.B., in the chair; Francis Cobb, Sir Westby P. Perceval, K.C.M.G., Admiral Sir Erasmus Ommanney, C.B., F.R.S., with Sir Henry Trueman Wood, Secretary to the Society, and S. Digby, Secretary to the Section. The arrangements for the Session were considered.

FIRST ORDINARY MEETING.

Wednesday, November 17, 1899; Sir FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., Vice-President of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Bubb, Henry, J.P., Ullenwood, near Cheltenham.
Bush, Montague, 23, Marlborough-place, St. John's-wood, N.W.
Carnelley, William, Fallowfield, Manchester.
Carr, Cuthbert Ellison, 1, Collingwood-street, Newcastle-on-Tyne.
Channon, Henry James, 20, Lewisham-hill, Lewisham, S.E.
Christy, Frank, 47, Broomfield-road, Chelmsford.
Church, Col. George Earl, 216, Cromwell-road, S.W.
Clarke, Lieut. Maurice Harvey, R.N.R., Coleswood, Harpenden, Herts.
Cooper, Rev. William Hargreaves, 9, Wellesley-road, Sheffield.
Cronin, Alfred Charles, 25, Kensington-palace-mansions, W.
Danson, Francis Chatillon, 74, Bidston-road, Birkenhead.
Davey, William John, 6, Water-street, Liverpool.
Driver, Charles William, 153, Sutherland-avenue, W.
Elliott, Walter John, M.A., 62, Springfield-place, Leeds.
Farnworth, Ernest, Rosslyn, Goldthorn-hill, Wolverhampton.
Ferguson, Charles J., J.P., Cardno-lodge, Carlisle, and 41, Elm-park-gardens, South Kensington, S.W.
Fogg, Charles Albert, 39, Park-road, Bolton, Lancashire.
Gamble, James Sykes, C.I.E., M.A., F.R.S., Highfield, East Liss, Hants.
Gray, Charles Joseph, Pietermaritzburg, Natal.
Gray, James, 5, Allan-street, Dalmarnock, Glasgow.
Hales, Charles, 4, Copthall-chambers, E.C.
Harris, Dr. F. Rutherford, Llangibby Castle, Usk.
Harvey, Surgeon-General Robert, M.D., C.B. D.S.O., The Yarrows, Simla, India.
Hunter, W. Henry, Oakhurst, Eccles Old-road, Manchester.
Hurst, Walter, 17, Doughty-street, W.C., and Tadcaster, Yorks.
Innes-Baillie, Charles J., Ballygunge, Grove-hill-road, Denmark-hill, S.E.
Klein, Walter G., 24, Belsize-park, N.W.
Lee, Arthur, J.P., 10, Berkeley-square, Clifton, Bristol.
Lyon, N. J., Guards' Club, S.W.
Morrow, Captain John, M.Sc., University College, Bristol.
Nuttall, Harry, Raynor-croft, Bowdon, Cheshire, and 2, Albert-street, Manchester.
Phillips, John, 81, Wood-lane, Treeton, Rotherham.
Ramsay, Alexander, 4, Cowper-road, Acton, W.
Romanes, John, 3, Oswald-road, Edinburgh.
Saunders, William Henry Radcliffe, 29, Bramham-gardens, South Kensington, S.W.
Strachan, Henry, L.R.C.P., M.R.C.S., Lagos, West Africa.
Stuart-Menteth, W. F., Municipal Office, Darjeeling, Bengal, India.
Tahourdin, Horace Foster, 63, Queensborough-terrace, Hyde-park, W.
Temple, Charles Lindsay, Vice-Consulate, Manaos, Amazonas, Brazil.
Tower, Christopher, The Weald, Brentwood, Essex.
Vincent, William Hugh, Corporation Electricity Works, Wellington-road, Ashton-under-Lyne.
Ward, Charles Blyth, Shirley, Sheffield.
Waterhouse, Mrs., Denehurst, Oxford-road, Moseley, Birmingham.
Webber, Wallace James, 6, The Avenue, Keynsham, near Bristol.
Younghusband, Major George I., Murree, Punjab, India.
Yoxall, James Henry, M.P., 7, Pagoda-avenue, Richmond, Surrey.

The CHAIRMAN commenced the proceedings by apologising, on behalf of Sir John Wolfe Barry, K.C.B., Chairman of the Council, for his absence. He was engaged on public business of the country, as one of the two representatives of Great Britain on the International Technical Commission on the Suez Canal. He had, however, left his inaugural address for the Session, which would be read by the Secretary, Sir H. Trueman Wood.

The SECRETARY read the following

ADDRESS.

BY SIR JOHN WOLFE BARRY, K.C.B., F.R.S.
Chairman of Council.

In my address delivered at the opening meeting of the last Session, I endeavoured to direct attention to the question of the inter-communication of the inhabitants of

London by means of our streets and thoroughfares, and I ventured to state that it was a highly important and urgent matter.

I pointed out firstly that at the present time 6,000,000 of persons were directly interested in the subject, for from suburban and Greater London streams of people are constantly passing in and out of the strictly urban portion of the metropolis, thronging the streets, many of which were made when the number of inhabitants was one-fifth or one-sixth of the present total. Secondly, that the daily influx of inhabitants from the outskirts of London to the central parts was, to a great extent, the creation of the last 30 or 40 years, and was owing partly to the development of suburban railways, and also greatly to the increased wealth of Londoners, which created a demand for travelling facilities, and enabled them to take advantage of those railways together with the tramways and other vehicular developments of all kinds, with which the capitalist class has so liberally supplied London and its environs during the past 40 years. The effect of these facilities for locomotion may be found in the fact that it seems no unreasonable estimate to suppose that 960,000 people enter and leave London daily by railways alone, and that the number of roadway vehicles has trebled in the last 27 years.

I gave many other statistics to which I need not now refer. They were interesting as showing the growth of traffic, and as an index of what may be expected in the future, but they were not necessary to bring home to the Londoner of to-day what is patent to everybody, viz., the fact that the traffic has overtaken the means for accommodating it, and that our main lines of arterial communication are intolerably overcrowded.

Since my address was delivered the police have taken the step of prohibiting empty cabs from moving about in search of fares. This may be necessary in the general interest, but it certainly deprives Londoners of a former considerable convenience, and it has necessitated the establishment in many of the main thoroughfares of cab ranks, which are in themselves most objectionable, in that they have the practical effect of seriously narrowing streets already too narrow for the moving traffic. When one sees rows of stationary empty cabs of great and hitherto unknown length occupying the middle of such streets as the Strand, Oxford-street, Queen Victoria-street, Pall-mall, Victoria-street, St. James's-street and Piccadilly, streets which are only of very modest widths, one cannot but recognise that the mere fact of these obstructions which have been allowed in lieu of "crawling cabs" is evidence itself of the fact that our streets cannot accommodate the traffic which desires to be moving in them.

I may point out in this connection that the width of a street is not to be judged of by merely considering the number of vehicles to be passed along it. It is valuable in a chief degree in order to permit of differences of speed. Thus, for instance, placing a cab-rank in Queen Victoria-street, for almost the whole distance from Mansion-house to Cannon-street, though it may still permit of four rows of moving vehicles, takes away a most important convenience by removing any facility for the inner rows of traffic adjusting their differences of speed, and, in fact, makes the street 12 per cent. narrower, and, probably, 25 per cent. less effective.

Such being the condition of things with a population of Greater London of 6,000,000, the question may well be asked what will be the traffic thrown on our streets in the next 30 years, at which time it has been estimated by competent authorities that the population may be doubled and reach the enormous total of 12,000,000.

I pointed out the absolute and immediate necessity which we have to face, of providing our working-classes with thoroughfares by which they can reach their homes from their places of employment; and, lastly, I showed how the great development of travelling from all parts of the kingdom, whether the travellers were on business or on pleasure bent, threw ever-increasing streams of traffic on our overcrowded streets.

So far as any efforts have been made to grapple with the question, I indicated that, whether compared with what has been done in other capitals or whether contrasted with the money which has been spent to bring traffic into London, the street improvements of the past 50 years were really extremely small. And I ventured to say:—

"When we come to consider more modern street improvements, most of them seem piecemeal and patchwork enterprises, narrowed to the very least dimensions which would pass muster, and without any but the most meagre provision for the future, or the slightest attempt at systematic artistic treatment. In fact, we cannot but note a hitherto incurable *petitesse* in dealing with such matters in London, contrasting remarkably with what we see in foreign cities of smaller importance and of far less wealth than the English metropolis."

The concluding part of my remarks were devoted to proposals, more or less precise, which I thought would do much to relieve the present congestion of traffic and make some provision for future demands. It is to those proposals and accompanying suggestions that I now desire to direct attention.

Whether my proposed streets and widenings were the right way to deal with admitted evils or not, I pleaded for a systematic consideration of the subject and the adoption of a comprehensive plan instead of hand-to-mouth expedients, which have been our custom, giving us new streets of inadequate width and irregularities of treatment which, in many cases, are almost ludicrous.

In the many notices and criticisms which were made of my remarks on the whole subject I do not think there was any denial of the facts which I had stated, nor was the necessity traversed for wider streets and other modes of accommodating traffic, &c.; but, as I had anticipated, I was dubbed "utopian" when I indicated some mode of curing the evils from which London is suffering, and the idea of spending the many millions which I admitted would be necessary in order to carry out my suggestions was, in some quarters, indicated as an unwarrantable and extravagant demand on the ratepayers of London.

It seems almost unnecessary to admit that in such a city as London any radical cure for evils which have been allowed to accumulate must involve heavy expenditure. But I want now to point out how large the financial issues are on the other side and to endeavour to show that a large expenditure may be prudently undertaken in view of the results to be attained.

Within the necessary limits of my former address, it was impracticable to discuss, with any approach to detail, the financial aspect of the street improvements which I suggested, and even now I can only hope to do so in respect to some points of view. But it may be profitable to endeavour to deal in this way with some of the more important of my proposals. I intend, then, to discuss, first, the estimated cost of the new and widened streets which I suggested, and of the crossings of east and west and north and south traffic, by means of bridges over or under the streets, at six of the important places of intersection:—

1. Hyde-park-corner.
2. Piccadilly-circus.
3. Ludgate-circus.
4. Oxford street and Tottenham-court-road.
5. Wellington-street and Strand.
6. Southwark-bridge and Upper Thames-street.

In approaching the figures of the estimated cost, I wish to lay stress upon two very important points.

First, that the net cost of such works is conditioned by the time given for the realisation of the properties forming the frontages of the new streets when made and of surplus property adjoining them.

Second, that the cost of the streets, however high, may be amply justified by the money saved to the public by improved means of locomotion.

To deal with the first of the above points it is obvious that if properties be bought at figures representing their extreme value at the time of sale, with an addition of 10 per cent. or more for compulsory sale, it is hopeless to resell them immediately except at great loss. Equally true, and indeed in a much aggravated form, is it recognisable that all moneys paid for trade compensation must be lost to the buyer unless time be given for trade to resettle itself, so that a trading value may become part of the property to be resold.

These considerations affect in a most material way the resale of what is known under the generic term of surplus properties of such undertakings, which are the areas of land of which some portion is required for a new street, but of which very considerable portions remain as open sites fronting to the new thoroughfare and so available for sale, as well as other properties not actually required for making the new street, but which are evidently required to give a depth which would render the frontage more valuable.

In all these cases time is as in so many questions the essence of the matter, and it is now a privilege of the London County Council generally recognised by Parliament that for great street improvements a period of fifty or sixty years should be allowed within which the Council may hold the ground-rents of the surplus property before they shall be required to sell it.

How great a relief this is, was well shown by Mr. Shaw-Lefevre in an able article in the *Contemporary Review* last February. He gave an ideal case in which the surplus property produces ground-rents of £35,000 per annum, which, if sold at once, would realise 28 years purchase, or a capital sum of £1,000,000.

He shows, in the first place, that the Council can borrow at 2½ per cent., which is

equivalent to 40 years' purchase, and as it is a regulation of Parliament that any capital sum realised by selling ground-rents must be employed in cancelling the Council's $2\frac{1}{2}$ per cent. stock, which was employed in purchasing the property, there is an evident gain of 12 years' purchase, or about £400,000, in retaining the ground-rents. But more than this, as the period approaches (as of course it will approach at the end of 60 years) at which the building leases will expire, the value of the property covered with buildings will be far above the capitalised value of the ground rent if sold within a few years of the building of the houses. How much this rise may be may be a question of opinion, but Mr. Shaw Lefevre, in his ideal case, puts the value at £4,000,000, as compared with the original £1,000,000, if sold at 28 years' purchase.

Mr. Shaw-Lefevre then deals with a concrete case, viz., that of the new street authorised between Holborn and the Strand, with all its accompanying improvements. He says that the County Council's officers estimate the total cost at £4,862,000, and the immediate selling value of the new frontages and surplus land at £4,088,000, showing a net commercial loss of £774,000. He goes on to say that owing to the privilege of the Council holding the ground-rents for 60 years, there is every reason to hope that this great improvement will not cost the ratepayers one penny. If his ideal case is to be applied as an illustration of the concrete example, Mr. Shaw-Lefevre might have stated the case very much more favourably for the ratepayers.

Now, if these calculations are correct, or even approximately correct, it is clear that well-designed street improvements, when undertaken by a great municipality commanding the use of capital at $2\frac{1}{2}$ per cent., and with the right of holding the land on each side of the new streets, are not enterprises to be set aside because the first cost may be, as I stated last year, many millions.

The great thoroughfare, 125 ft. wide from west to east of London, which I advocated, would, with subsidiary connections, be $5\frac{1}{2}$ miles in length, and though no doubt much of the property is very valuable, yet a large proportion of it is residential property, not of the very highest class where no trade interests have to be bought. On the other hand, in some portions, especially at the eastern end, the first cost of purchase of the sites would be very high. On the whole, I should imagine, and I am fortified in this by the opinion of one of the first land valuers of London, that after making an allowance for the greater width, my new street would not compare, yard for yard, unfavourably with the street from Holborn to the Strand, which from Wellington-street to St. Mary-le-Strand involves the compulsory purchase of four theatres, and the great building occupied by the offices of *The Morning Post*, the whole undertaking being four-fifths of a mile in length.

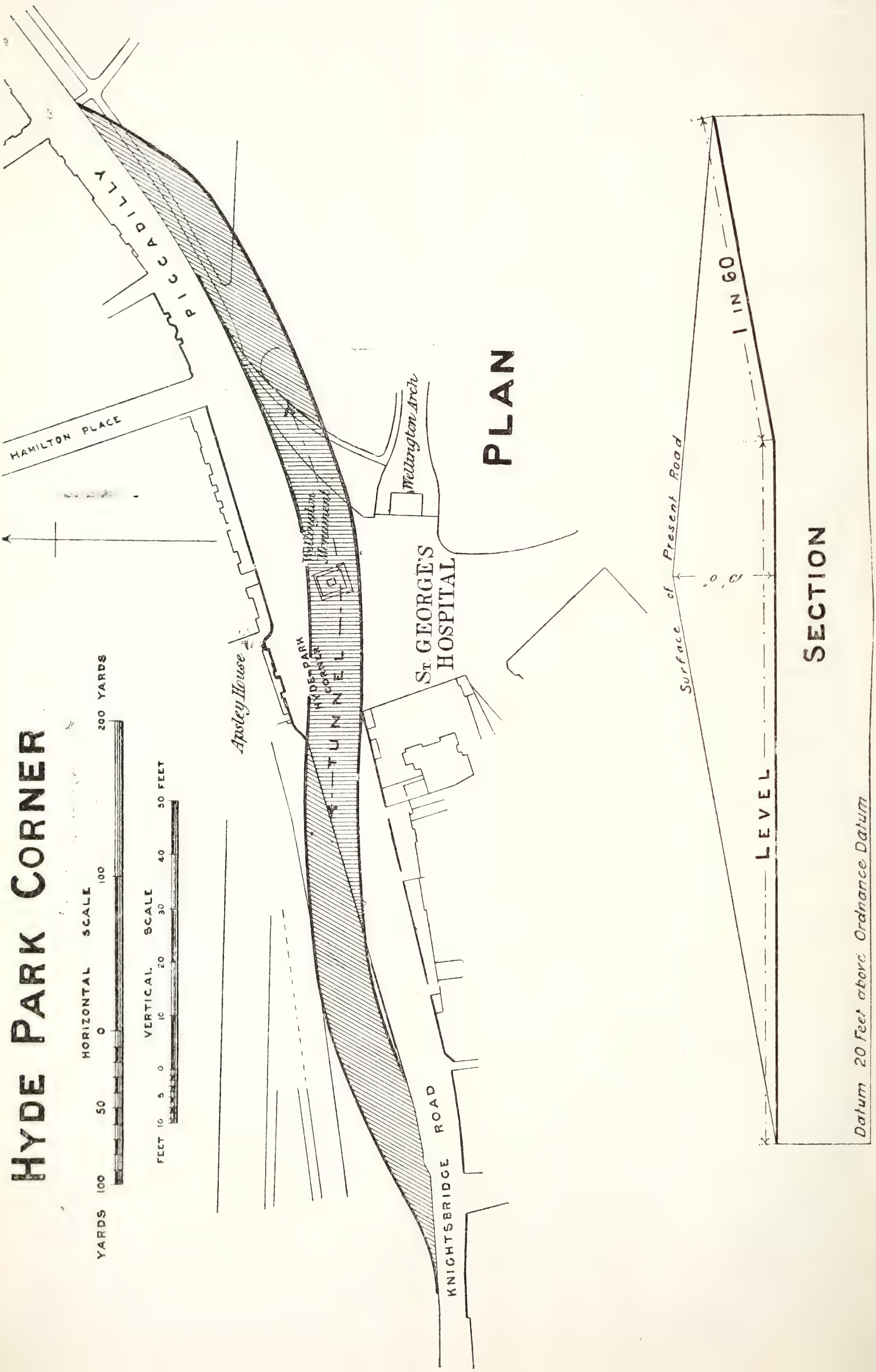
If this mode of estimate be permissible, we should see that the nett cost of the new street from east to west through London, assuming that the ground-rents were sold at once, would be £5,750,000, and that if the ground-rents were retained for 60 years, the street could be made without any ultimate financial burden on the ratepayers.

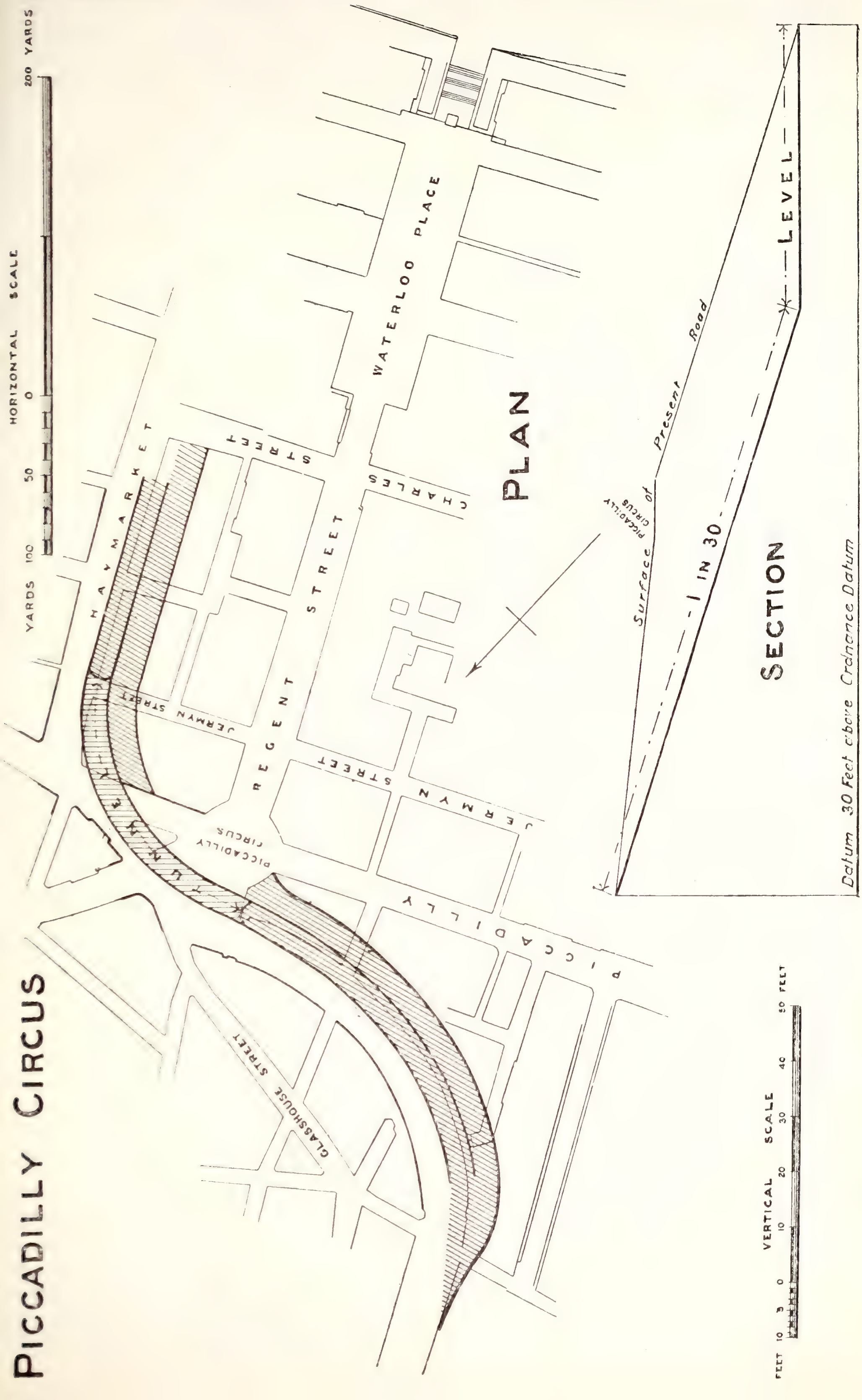
This great new street was the principal item of expenditure in my suggestions, but it was by no means all. I have endeavoured to form an idea of the cost of the other recommendations, and without wearying you with the details, I arrive at an additional cost of about £1,420,000.

Assuredly, in view of the calculations of the Chairman of the Improvement Committee of the London County Council, in a similiar case, there seems to be nothing so alarming in the cost of the improvements which I suggested, spread, as it would be, over a considerable number of years. It is easy to raise bogies when any proposal is brought forward for dealing with subjects in a comprehensive way, as contrasted with what I ventured to describe as the "piecemeal" mode of approaching such matters, which seems inherent in the British municipal mind.

I am bound in fairness, when quoting Mr. Shaw-Lefevre, to add that in the article to which I have alluded, he expresses doubts as to the expediency of a broad thoroughfare from east to west through London, first, on account of the cost, though he himself almost proves it to be perfectly within our means, and, secondly, because he doubts "whether it would relieve Oxford-street of a single omnibus."

As to whether it would relieve the traffic of existing thoroughfares, and make provision for the wants of the future, I venture to think this might be left to the judgment of the public, who seldom go wrong on such matters. It seems to me unreasonable to question its utility. If last July, when the Thames-embankment was under repair, Mr. Shaw-Lefevre had seen the block of vehicles in the


HYDE PARK CORNER
HORIZONTAL SCALE
YARDS 100 50 0 100 200 YARDS
VERTICAL SCALE
FEET 10 5 0 10 20 30 40 50 FEET
PICCADILLY
HAMILTON PLACE
Apsley House
Wellington Arch
Wellington Monument
HYDE PARK CORNER
TUNNEL
St. GEORGE'S HOSPITAL
KNIGHTSBRIDGE ROAD
PLAN
1 IN 60
Surface of Present Road
LEVEL
SECTION
Datum 20 Feet above Ordnance Datum


PICCADILLY CIRCUS
HORIZONTAL SCALE
YARDS 100 50 0 200 YARDS
PLAN
WATERLOO PLACE
CHARLES STREET
REGENT STREET
JERMYN STREET
HAYMARKET
PICCADILLY CIRCUS
PICCADILLY
GLASSHOUSE STREET
SECTION
LEVEL
Surface of Present Road
1 IN 30
PICCADILLY CIRCUS
Datum 30 Feet above Ordnance Datum
VERTICAL SCALE
FEET 10 5 0 10 20 30 40 50 FEET

Strand and Fleet-street, in which I myself was involved for nearly 40 minutes, he could not have doubted that the parallel roadway, 110 feet wide, of the Thames-embankment is of daily and hourly of enormous benefit to Londoners, though in this case it is to be noted that the Thames-embankment does not ordinarily relieve the Strand and Fleet-street of any omnibuses. When, however, the traffic of the Embankment was all diverted to its old course the confusion was unparalleled in my recollection of London streets.

Again, those who have seen the effect of widening Parliament-street lately to a width of 125 feet have an object-lesson, and will not have much difficulty in realising what a boon such a street extending from Bayswater to Whitechapel would be to the traffic of London.

As to the service which the new thoroughfares would render, there really cannot be any question, and thus the important matters are what would be the eventual not the first cost, and what is the money cost due to the present inconvenience of London streets.

Before, however, dealing with this latter question I wish to say a few more words as to the proposals which I ventured to put forward last year for crossing the north and south streams of traffic over or under the principal east and west streets, so as to avoid the serious delays and confusion at these places to which we are only too well accustomed. I suggested that this should be done at Hyde-park - corner, Piccadilly - circus, Ludgate-hill, the south-end of Tottenham-court-road, Wellington-street, Strand, and Queen-street, City, by viaducts and bridges or by sunken roads as in each case might be more suitable. The relief to the main thoroughfares and the quickening of both streams of traffic by such improvements would be extremely important.

I went on to say that crossings, such as I indicated, would require much study as to their best and most ecomonical lines and levels, and I could not within the limits of my address last year do more than state that I had satisfied myself that there is nothing impracticable in the suggestion, and that I felt confident that such improvements would be worth their cost, which, no doubt, would be considerable.

Since last year, I have looked more carefully into the circumstances of each case, and have laid down the lines of the works in question. These are shown in the diagrams, and I will briefly describe them.

1. *Hyde - park - corner.*—In this case the west and east traffic would pass under the stream going north and south by means of a broad sunken road, leaving the Knightsbridge road on the north side, and rejoining Piccadilly on the south side. A strip of land of an area of 3·1 acres would be required from Hyde-park and from the Green-park, and practically no buildings would be affected. It would consequently be a cheap undertaking.

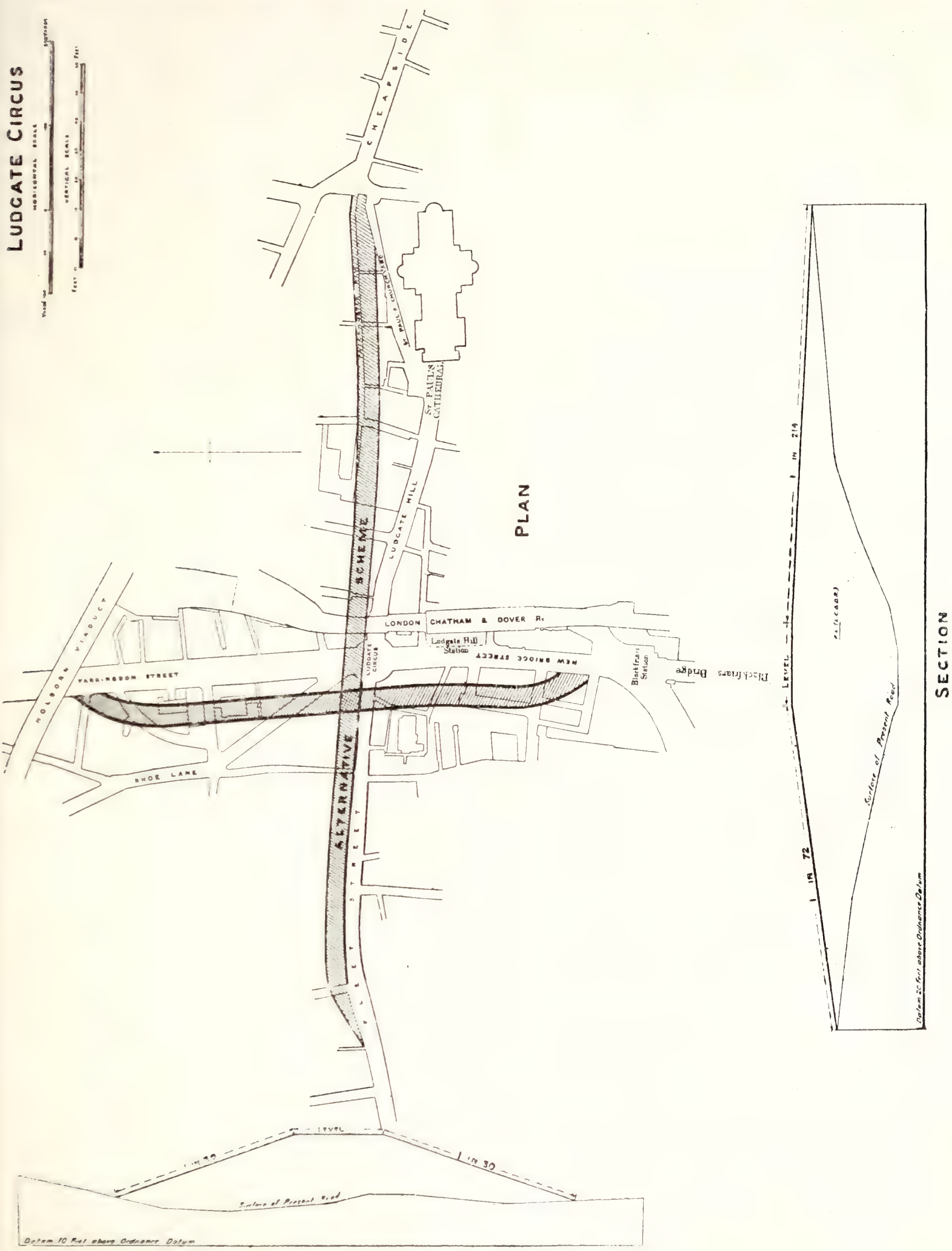
2. *Piccadilly-circus.*—This is a much more difficult and a highly expensive work. The north and south traffic would cross under the west and east traffic by means of a central sunken road descending from the north end of the Regent - street quadrant opposite Vigo-street, passing under Piccadilly - circus, and emerging in the Haymarket, the portion under Piccadilly-circus and Coventry-street being in tunnel for a length of some 180 yards, with openings for light and air.

3. *Ludgate - hill.*—In this case the north and south traffic would be crossed over the east and west stream by means of low viaduct and bridge. The natural way of dealing with this crossing would be to cross the east and west lines over the north and south, as the gradients of Fleet-street and Ludgate-hill lend themselves to that arrangement. But the railway bridge across Ludgate-hill necessitates the other plan of crossing, unless a very formidable work somewhat like the Holborn-viaduct were undertaken, which, apart from cost, would no doubt be a better mode of dealing with the traffic, and would have the great advantage of avoiding the inclines of Ludgate-hill and Fleet-street. Setting this aside for the moment as too expensive, and dealing with the more modest scheme of crossing the north and south traffic over Fleet-street, the proposed viaduct would leave New Bridge-street on the west side and join Farringdon-street on its west side. It would involve interference with a certain amount of valuable property, but the existing-frontages would be to a great extent preserved, and, of course, new frontages would be created. I have shown the alternative of a high viaduct running east and west on the sketches, and every one can see that apart from cost it is the better scheme.

4. *Oxford-street and the south end of Tottenham-court-road.* — At this place the west and east traffic would cross over Tottenham-court-road on the north side of Oxford-street. The properties are not extremely valuable, as it would be possible to avoid the Oxford Music-hall and other important build-

ings fronting Oxford-street by keeping the new high level road about 150 feet to the north. The gradients might involve the raising of the level of Oxford-street opposite Rathbone-place some two or three feet, otherwise no considerable difficulties would be encountered.

5. *Wellington-street, Strand.*—In this case the crossing ought to form part of the present scheme of the London County Council for their new street to Holborn, if it is to be a really successful work. The gradient of Wellington-street clearly indicates that the north and



SECTION

south traffic should cross over the Strand. With the exception of the Lyceum Theatre the property is not specially valuable. The County Council do not think much of theatres for they are going to acquire, as above indicated, four in connection with the street to Holborn and Strand improvement. The crossing street would ascend from the corner of Tavistock-street and Wellington-street by easy gradients, keeping to the west side of the latter street and descend by a grade of 1 in 30 to rejoin Wellington-street at the north end of Waterloo-bridge.

6. *The passing of the north approach of Southwark-bridge over Upper Thames-street.*—This is a work which speaks for itself and presents no serious difficulties. The crossing street would continue the level of the north end of Southwark-bridge and would be parallel to and to the east of Queen-street, descending to rejoin the existing level at the corner of Cannon-street and Queen-street.

Having, then, laid the foundation by estimating—in the way which I have mentioned—the cost of the improvements on the north side of the Thames, which I suggested for consideration, I now reach the second of the main questions to which I alluded above, viz., what is the money which would be annually saved by the inhabitants of London by improved means of communication.

Now it is obvious that the adequacy of streets of a town for its trade and commerce must be a question of proportion, and I think it will be generally admitted that London has fallen behindhand in this respect. But it is difficult to put the deficiencies of our metropolis into pounds, shillings, and pence. I propose, however, to make some attempt to do so, though I am free to confess that any mode of estimating must be open to criticism, because we are dealing, to a great extent, with calculations of value on which opinions may widely differ.

It may be remembered that last year I quoted two estimates made many years ago of specific instances where traffic was impeded and delayed.

The first was an estimate by Colonel Haywood, in the year 1867, of the loss annually due to the delays caused by the Holborn-hill and its right-angled crossing. This estimate amounted to £100,000, and took account only of the loss to those owning vehicles and horses, and omitted the loss sustained by passengers in the vehicles and by foot-passengers.

There can be little doubt that the loss at the Ludgate-hill, Wellington-street, Strand, and Piccadilly level crossings must in 1899 be in each case at least as much as at Holborn-hill in 1867. We may perhaps put the other three crossings of my list as equal to one Holborn-hill crossing, and if these figures are correct, we arrive at the startling figure of £400,000 per annum for the six crossings in question.

The second estimate, made over 30 years ago, was that a loss of from £400,000 to £500,000 a year was sustained by Londoners in the difficulties under which the coal trade alone lay in consequence of restrictions under which it was necessary to place it.

The loss due to Holborn-hill has been stopped by the construction by the City of the admirable Holborn-viaduct and its accompanying streets. But the loss on trade remains practically untouched, and has no doubt grown to far larger proportions during the years which have elapsed since the estimate was made.

Now we know that the coal trade, large as it is, forms only a part of the carted trade of London. The coal trade is but a small percentage of the whole goods and merchandise brought into London; most of us are acquainted, for example, with the restrictions placed on the carting of building materials or the removal of the results of excavations.

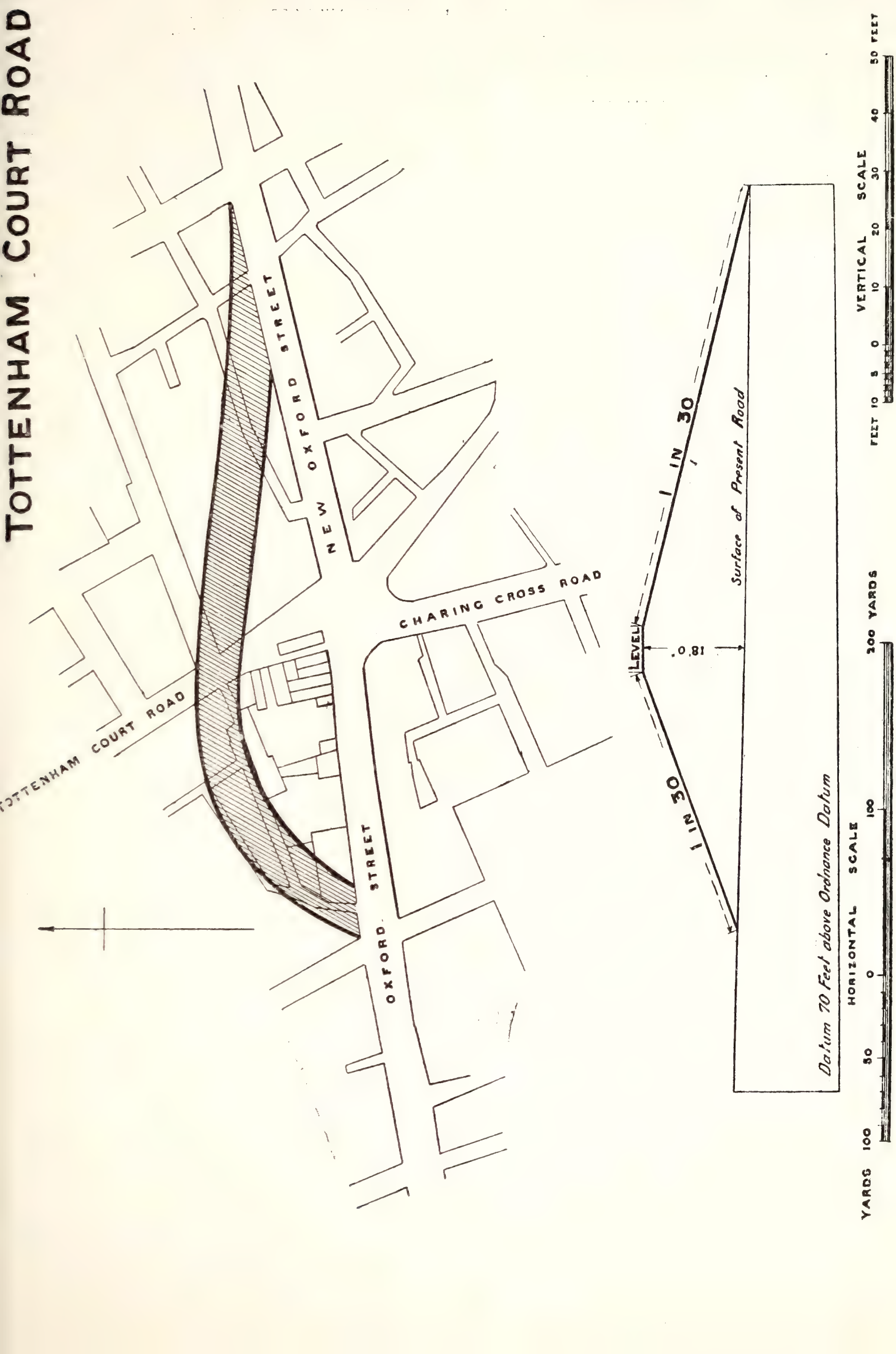
If the estimate of the coal trade should now be taken as £450,000 a year, it seems to me that it might be safely doubled to include other trades, and we so reach a sum of £900,000.

I will now refer to certain statistics which I have obtained as to delays to all descriptions of traffic. They are based, in the first instance, on the enumerations of vehicles made by me last year in three of the principal thoroughfares, enumerations not taken at a busy time of the year when London is full, but in the month of October. I feel sure that if May or June had been chosen the figures would have been much higher.

However, subject to this qualification, I found that in one hour the following numbers of vehicles and pedestrians passed a given spot:—

	Vehicles.	Pedestrians.
Cheapside	992	6,358
The Strand	1,228	5,660
Piccadilly	1,497	3,910
Tottenham-court-road ..	661	5,586

It is to vehicles and pedestrians in such numbers that obstructions occur, and I want, if possible, to arrive at some idea of the amount


TOTTENHAM COURT ROAD
NEW OXFORD STREET
CHARING CROSS ROAD
TOTTENHAM COURT ROAD
OXFORD STREET
1 IN 30
LEVEL
.0.81
1 IN 30
Surface of Present Road
Datum 70 Feet above Ordnance Datum
VERTICAL SCALE
FEET 10 5 0 10 20 30 40 50 FEET
HORIZONTAL SCALE
YARDS 100 50 0 100 200 YARDS

of delay, and of the consequent unnecessary expense to which such volumes of traffic are now subjected by want of adequate streets.

By another enumeration I found that in an hour the following number of omnibuses included in the above figures, pass a given spot:—

Cheapside	384
The Strand	444
Piccadilly	423
Tottenham-court-road and Oxford-street junction	487

I think we may thus assume that, on the four routes in question, we have to deal with an hourly traffic during the working part of the day, of 1,750 omnibuses, 1,500 cabs and carriages, and 1,000 carts.

There is, of course, much difference between different parts of the day in respect of the over-crowding of traffic—the amount of delay which it occasions. I do not think we should be far wrong in taking an average of 9 hours per day (say from 9.45 a.m. to 6.45 p.m.) as the period during which three of the routes mentioned are overcrowded, and in the case of Piccadilly, a period of 11 hours, recognising that the amount of overcrowding is by no means uniform during the hours in question.

Thus we arrive at the fact that on these four routes only each day 16,650 omnibuses, 14,900 cabs and carriages, 9,700 carts and other vehicles find their course impeded and delayed by the crowded state of the streets.

The absolute amount of retardation is a matter of estimate from observation, and presents some difficulty.

I have had the time taken of vehicles in crowded and less thronged and free parts of the main thoroughfares, and I find that the amount of retardation in different parts of the four main streets alluded to, varies from 10 per cent. to 44·8 per cent., as compared with the speed in unimpeded parts of the street.

As an example I find by observations that the speed of a hansom cab from Liverpool-street to Victoria, with a remarkably good horse, on a by no means exceptionally crowded day, varied along the route from a speed of 4 miles an hour to a speed of 10 miles an hour on the Thames-embankment and 9 miles an hour in Whitehall.

A series of observations as to the speed of omnibus traffic in impeded and unimpeded streets also corroborates this view.

From these considerations I think that I am underestimating the retardations due to overcrowding at 20 per cent. on the four routes in question, which is equivalent to saying that one allows four minutes additional on a journey which, if the streets were as wide as Whitehall, would occupy 20 minutes.

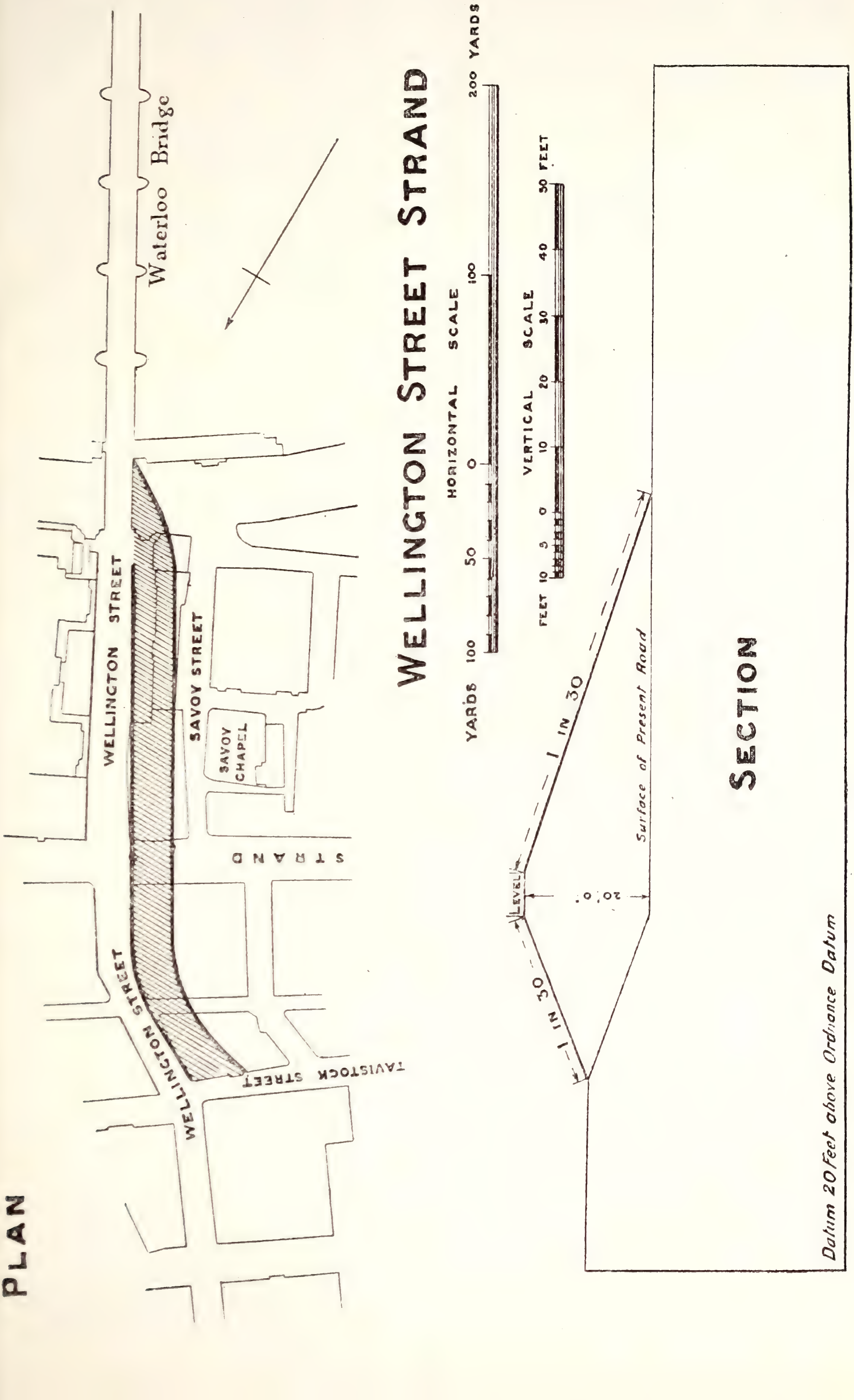
I am anxious not to over-state the case, and I know in my own practice that I allow far more than such a per-centage when I have to keep an appointment or catch a train.

For instance, I often have to drive from Westminster to Broad-street and I find that at least 25 minutes must be allowed, and the distance, which is $2\frac{1}{2}$ miles, should be covered easily in 18 minutes.

But taking for calculation 20 per cent., to what does it amount in money for the loss of the time of the vehicles and passengers. The value of the time of the vehicles and driver can be pretty nearly arrived at, and I assume in this respect 4s. per hour for an omnibus, 2s. 6d. per hour for a cab, and 2s. an hour for a cart. We then have the passengers, and I take 10 passengers in each omnibus at 9d. per hour, $1\frac{1}{2}$ passengers per cab, and private carriage at 3s. per hour. Of course, difference of opinion may arise as to these rates of value for the time of passengers, but when we remember the large number of professional men, and of the mercantile classes who are delayed in cabs and carriages, 3s. per hour seems a moderate figure for that class of vehicle, and will allow for those, male or female, whose time is of little value. Similarly, when a working man's time is valued at 1s. per hour, my estimate for the omnibus passengers does not seem high after making allowances as before.

It would be wearisome if I went into all the details of the examination which I have given to the subject, but applying these figures to the volume of traffic in the four streets in question, it would appear that the hourly traffic in these streets involves £1,631 per hour. If this is delayed 20 per cent., it means a loss, in respect of vehicular traffic only, of £880,740 per annum. There remains to be added the traffic of the Euston-road, and Queen Victoria-street if we are to include the chief east and west routes, and perhaps these may be taken at about 15 per cent. of the above figures. We have to include the traffic which crosses these four chief routes, and is there greatly delayed, and this, I think, may be taken at about 20 per cent. of the above figures of the east and west streams.

In addition to vehicular traffic we have pedestrian traffic to consider. Applying the same mode of calculation as above, and for


PLAN
Waterloo Bridge
WELLINGTON STREET
SAVOY STREET
SAVOY CHAPEL
STRAND
TAVISTOCK STREET
WELLINGTON STREET
WELLINGTON STREET STRAND
HORIZONTAL SCALE
YARDS 100 50 0 100 200 YARDS
VERTICAL SCALE
FEET 10 5 0 10 20 30 40 50 FEET
1 IN 30
LEVEL
20'0"
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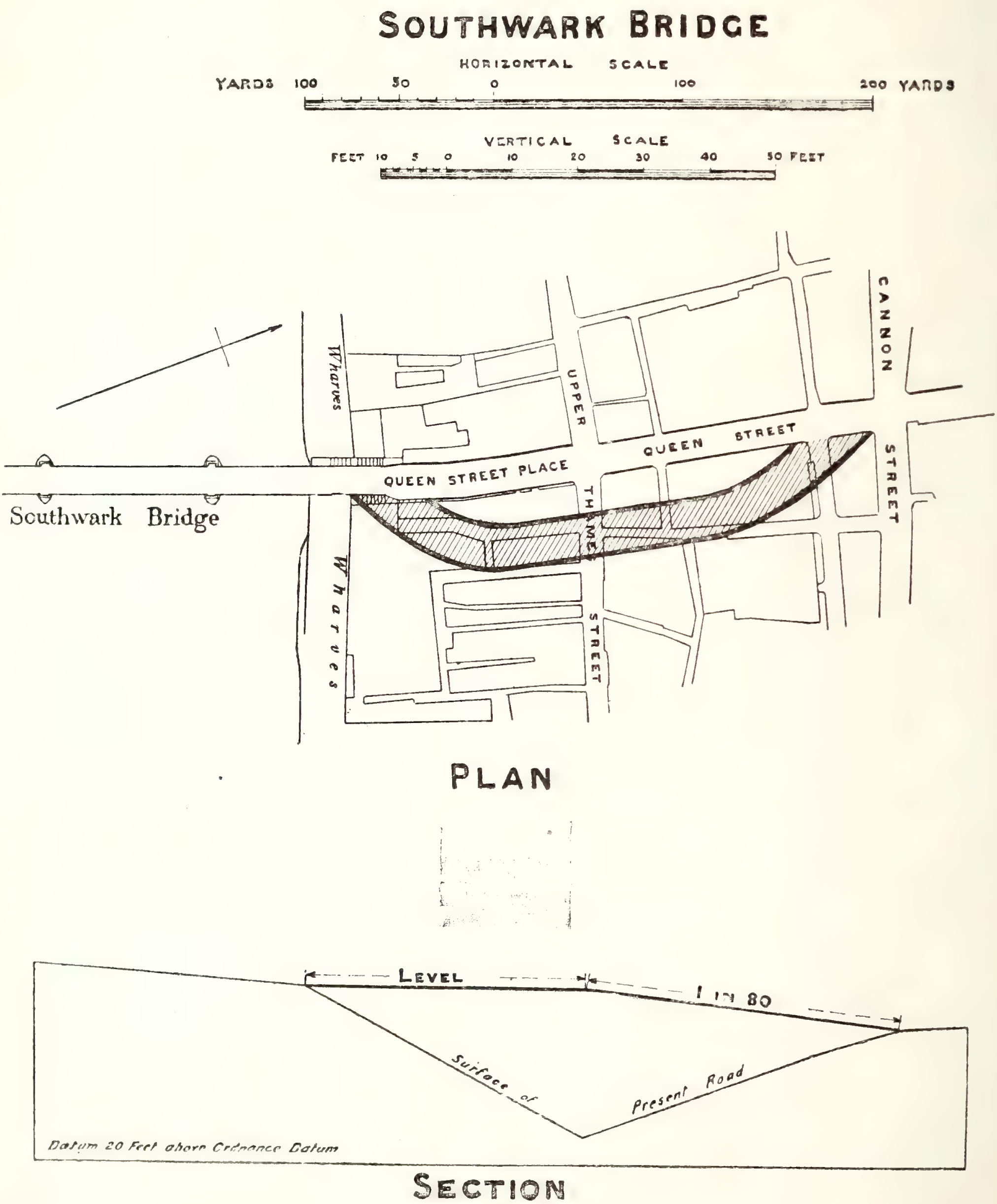
Surface of Present Road
SECTION
Datum 20 Feet above Ordnance Datum

observations taken, I come to the conclusion that this traffic (21,514 individuals in all, per hour, in the four streets under consideration) is delayed to the extent of one-third of the delays to vehicular traffic or, say 6·6 per cent., and if



we assume a value per hour of 4d. per individual, allowing for females and non wage-earning persons, we arrive at an annual loss £65,000.

To sum up, therefore, I arrive at an annual loss on the various routes above discussed of—

Trade interests	£900,000
Vehicular traffic	1,189,000
Pedestrian traffic	65,000
	£2,154,000

I do not pretend that these figures can be more than an attempt to put before you in money the daily and hourly inconvenience which Londoners sustain by narrow overcrowded streets, and I should not have attempted to estimate the money value except

for the purpose of trying to see something of the relation between capital and revenue.

That a very large amount of money is being wasted will not be denied, nor can it be doubted that whatever the loss may be it is getting worse and worse every year. But neglecting this consideration, and capitalising the present loss, whatever its true figures are, at 30 years' purchase, we can see that many more millions of expenditure in improving the facilities for traffic on the north side of the Thames than I have estimated would be commercially justifiable.

I feel sure that this is taking a low view of the financial aspect, for impediments to trade and commerce cannot be appraised by merely taking the value of vehicles, horses and drivers, and the wages or salaries of passengers.

Again, it leaves out of account all other matters referred to in my address of last year, such as the impossibility of tramways and the dangers to bicycle traffic, the safety of travellers, all æsthetic considerations and influence on pleasure traffic which our continental neighbours, at least, value highly, and for which they make streets and boulevards, which utterly shame the meanness of London thoroughfares.

Again, then, I enter my plea for a systematic consideration of this great subject as compared with hand-to-mouth attempts to cure isolated evils when they become too intolerable. Let us not fold our hands or allow our representatives to persuade us that all is for the best in London. We want a large-minded plan for dealing with admitted evils, a plan to be worked to gradually, and one which, when realised, will really accommodate our present and future traffic, and be a credit to the metropolis of Greater Britain.

After the reading of the Address, the Chairman presented the Society's medals which have been awarded during the last session.

For papers at the Ordinary Meetings :—

To PROF. GEORGE FORBES, F.B.S., for his paper on "Long Distance Transmission of Electric Power."

To C. H. BOTHAMLEY, F.C.S., for his paper on "Photographic Developers and Development."

To DIXON H. DAVIES, for his paper on "The Cost of Municipal Enterprise."

To JAMES SWINBURNE, for his paper on "Nernst's Electric Lamp."

To J. H. COLLINS, for his paper on "Cornish Mines and Miners."

To PHILIP DAWSON, for his paper on "Electric Traction and its Application to Surburban and Metropolitan Railways."

To WALTER HUNTER, M.Inst.C.E., for his paper on "London's Water Supply."

To SIR WILLIAM HENRY PREECE, K.C.B., F.R.S., for his paper on "Ætheric Telegraphy."

In the Indian Section :—

To COLONEL RICHARD CARNAC TEMPLE, C.I.E., for his paper on "The Penal System at the Andamans."

To SIR JOHN SCOTT, K.C.M.G., D.C.I., for his paper on "Judicial Reforms in Egypt in Relation to the Indian Legal System."

In the Foreign and Colonial Section :—

To ARCHIBALD LITTLE, F.R.G.S., for his paper on "The Yanygtse Basin and the British Sphere."

In the Applied Art Section :—

To STEPHEN WEBB, for his paper on "Intarsia, or Inlaying."

To J. STARKIE GARDNER, F.G.S., for his paper on "The Revival of Tradesmen's Signs."

The CHAIRMAN proposed a vote of thanks to Sir J. Wolfe Barry for having so ably pursued the subject with which he dealt last year. The improvement of the traffic of London was really a most pressing matter. Anyone who was dependent on cabs, carriages, or omnibuses knew that in these days it was practically impossible to get along, and that even the very means which were taken to regulate the traffic were themselves sources of great inconvenience. He could not help thinking that admirably as the policemen did their work, they got occasionally into the way of thinking that they must stop the traffic each way from time to time, even when it was sparse, and when it might very well be left to continue on both roads at once. That was his experience in going home from Westminster to Queen's-gate. He was compelled to avoid the road by Constitution-hill, past Hyde-park-corner, and Albert-gate, because there were two police stops, which between April and August practically occupied a few minutes each, and he had to drive round by Lowndes-square to avoid them. That did not so much matter when going home, but when anyone wanted to save a train it mattered a great deal. The proposal to give immediate relief by these cross traffic improvements was worthy of all consideration. No doubt they would be costly in themselves, but not in comparison to their importance in main arterial thoroughfares, and the relief afforded would be enormous, and he hoped that those to whom the government of London was entrusted would take the matter seriously into consideration. It occurred to him that in making a principal street the system pursued in the old city of Chester might well be adopted—that of the

Rows. This would give a double line of shop frontages, one on the road level, and one above, faced by a footway not liable to interruption by vehicles, or the annoyance of mud spattering, and from those elevated walks bridges might be thrown across the main streets at intervals, as well as over the side streets. These would lend themselves most effectively to picturesque architecture. He was sure they would all thank Sir John most heartily for the extremely valuable paper he had submitted.

Sir JOHN DONNELLY, K.C.B., in seconding the vote of thanks, said they all felt the necessity for some improvement in this direction. He could speak feelingly on the matter, for in attempting to cross at the top of St. James's-street, a few days ago, he was knocked down by a motor car. This crossing traffic certainly required dealing with at once, and it could evidently be done at comparatively small cost. Whether it would be done within any reasonable time he had great doubt, for it was something like 35 or 40 years since Captain Fowke put forward a very good proposal for managing the traffic at Hyde-park-corner. He proposed to carry a tunnel from the top of Grosvenor-place, under Piccadilly, to Hamilton-place, but though no one had anything to say against it that he knew of, the proposal was not carried out. He hoped some pressure would be brought to bear on the government of London to force on the consideration of this important matter.

The vote of thanks was carried unanimously.

Sir OWEN ROBERTS then proposed a vote of thanks to Sir Frederick Bramwell for so efficiently presiding over the proceedings.

Mr. J. SWAN seconded the proposal, which was carried unanimously; and

The CHAIRMAN having briefly acknowledged the compliment, the meeting was adjourned.

Correspondence.

CONGRESS OF HYGIENE AND DEMOGRAPHY.

SIR,—My attention has been drawn to Captain Abney's letter, in the number of your *Journal* for September 29th (vol. xlvii., p. 838), about the Tenth International Congress of Hygiene and Demography, to be held in Paris early in August next.

I, therefore, write to say that there is a permanent English Committee for these Congresses, and that the secretary is Dr. Paul F. Moline, 42, Walton-street, Chelsea, S.W., and the Treasurer, your obedient servant,

W. H. CORFIELD.

19, Savile-row, W.
Nov. 11, 1899.

General Notes.

RAILWAYS IN INDIA.—The number of miles of railways in India open for traffic and in construction at the end of 1898-99, was as follows:—State railways, open for traffic, 16,644, in progress, 1,750; guaranteed and assisted, open, 3,690, in progress, 706; Native State, open, 2,084, in progress, 1,112; Foreign State (French and Portuguese India), open, 73. The total mileage of all railways, 22,491 miles open and 3,568 miles under construction.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C. (Cantor lectures.) Mr. Henry Hardinge Cunynghame, "Enamelling upon Metals." (Lecture I.)

British Architects, 9, Conduit-street, W., 8 p.m. Dr. Murray, "Excavations in Cyprus in 1896."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. E. Hull, "The Route of the Exodus from Egypt to Palestine."

TUESDAY, Nov. 21...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussions on following papers:—1. Mr. H. H. Dalrymple-Hay, "The Waterloo and City Railway." 2. Mr. Bernard M. Jenkin, "The Electrical Equipment of the Waterloo and City Railway."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. R. F. Crawford, "Notes on the Food Supply of the United Kingdom, Belgium, France, and Germany."

Photographic, 66, Russell-square, W.C., 8 p.m. (Photo-Mechanical Meeting.) Mr. Henry W. Bennett, "Architectural Photography."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Northumberland-avenue, W.C., 4½ p.m. Mr. A. W. Andrews, "The Empire and Geographical Teaching."

WEDNESDAY, Nov. 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. D. E. Hutchins, "National Forestry."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-square, W., 1 p.m.

THURSDAY, Nov. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Foreign and Colonial Section.) Mr. John Ferguson, "Old and New Colombo."

Royal, Burlington-house, W., 4½ p.m

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. S. M. Vines, "The Highest Andes."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. John Holliday, "The Cost of Steam Raising." 2. Mr. R. E. Crompton, "Influence of Cheap Fuels on the Cost of Electrical Energy."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. B. Worsfold, "England in South Africa." (Lecture III.) "The Attempt to Reunite the States and Colonies by Federation.

FRIDAY, Nov. 24...Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 8 p.m. Lord Charles Beresford, "Openings for Mechanical Engineers in China."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, 5 p.m.

SATURDAY, Nov. 25..Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, NOVEMBER 24, 1899.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, 1900, at 7 o'clock, by HERBERT JACKSON, on "The Phenomena of Phosphorescence."

Due notice will be given when the tickets for the lectures are ready for issue.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received. Subject to these conditions each member is entitled to a ticket admitting two children and an adult.

CANTOR LECTURES.

On Monday evening, 20th inst., Mr. HENRY HARDINGE CUNYNGHAME delivered the first lecture of his course on "Art Enamelling upon Metals."

The lectures will be printed in the *Journal* during the Christmas recess.

Proceedings of the Society.

SECOND ORDINARY MEETING.

Wednesday, November 22, 1899; Sir GEORGE BIRDWOOD, K.C.I.E., C.S.I., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Daymond, John, Dunrobin, Bedford-hill, Tooting-common, S.W.

Garrett, Albert E., 127, Lothair-road, Finsbury-park, N.

King, Daniel, 14, St. Mary-axe, E.C.

Moorhead, James, Exchange-buildings, Cardiff.

Nariman, Bahadur K., L.R.C.P., B.G.J.P. Railway, Bhavnagar, Bombay.

Oakey, Herbert, Caton-lodge, 13, High-road, Streatham, S.W., and Wellington-mills, Westminster-bridge-road, S.E.

Ravenshaw, Albert Francis, 102, Croxted-road, Dulwich, S.E.

Wilkinson, Charles Herbert, Halton-house, Cheshunt, Herts.

The CHAIRMAN said:—I occupy the chair this evening merely as a substitute. General Michael, who is so well known to, and so highly respected by you all, both for his work as a pioneer of forest conservancy in India—in the Presidency of Madras—and for the interest he has always taken in the promotion within this Society of discussions on forest conservancy, was to have presided here this evening, as on previous similar occasions, but a few days ago an ailment he has been suffering from for some years took a turn for the worse, necessitating a trying operation, which was fixed for Sunday last. It was impossible, thererore, for him to be with us this evening. I am sure we deeply regret his absence, and earnestly hope that he may soon be restored to his usual cheery good health. Mr. Ernest Hutchins, the author of the paper of the evening, is also absent; and his paper will therefore be read for him by Professor W. R. Fisher, of Cooper's-hill College. Mr. Ernest Hutchins was formerly a member of the Forestry Department of the Government of India, where he served in the Presidency of Madras for six or seven years. After this he took up a similar appointment under the Government of Natal, whence later on he transferred his services to the Government of Cape Colony, where he now is. He is not only an accomplished botanist, and a practical forester, but a scientific meteorologist of wide reputation. While serving under the Forestry Department in the Presidency of Madras, he invented a self-registering rain-gauge, which can be left for months in remote forests, and keep an unfailing record of the rainfall. Since he went to South Africa he has devoted, much thought to the subject, and has come upon the apparent trace of some subtle connection between the fluctuation of the seasons in Africa and India. Indeed, he would now seem to have established the fact of such a connection, for during the past two or three years he has been able to furnish the Government of India with information that has proved of real value to their meteorologists in forming forecasts of the probable date and volume—that is earliness or lateness, and force or feebleness—of the marvellous and beneficent phenomenon of the south-west monsoon. His observations in this respect have led Mr. Ernest Hutchins to be a strong believer in the periodicity of seasons of scanty and abundant rainfall, and corresponding agricultural famine and plenty in India. This is a conclusion in which every scientific man will be disposed to concur; and only ignorant or dishonest political partisans would attempt to gainsay it. The paper with which he has favoured us this evening is one of remarkable interest, and will excite attention far

beyond the limits of this room. It is conceived in at once a thoroughly philosophical, scientific, and practical spirit, and is written with the greatest clearness, logical force, brevity, and simplicity. A sound and telling point is made in almost every paragraph; and it will rouse, and interest, and charm everyone who hears it, or reads it in the *Journal*. It is gratifying to me, not only to have been asked to take my dear friend General Michael's place here this evening, but to have had the privilege of presiding at the reading of so valuable and stirring a paper as that which Mr. Ernest Hutchins has provided for us. I will now ask Professor Fisher to read it.

The paper read was—

NATIONAL FORESTRY.

By D. E. Hutchins,
Conservator of Forests, Cape Town.

Some years ago, when last on leave in England, I climbed one of the highest of the Welsh mountains, and gazed with sorrow on the prospect around. Barren heather-clad hills bounded the view on every side, affording, I was told, but a scant pasturage for the few lean flocks of sheep I had seen on its slopes. It was an ideal forest country. Old records and names indicate more or less exactly where the forest once stood. The climate is a superb one for forests. I can readily imagine the close, clean, mast-like stems it must have produced. What would we not do with such a range of country in South Africa?

Now it pastures a few sheep! Sheep that could be pastured better in Australia or in South Africa, where it is too dry or hot to grow coniferous timber. When the old forest was cut down the usual soil deterioration followed. What was once a rich forest soil is now barren moorland. The contrast was all the greater as I had come straight from a tour in the Black Forest in Germany, where the reverse side of the picture is strikingly presented. There almost every square yard is utilised. In the fertile bottom lands of the valleys, sheltered and enriched by the forest, are villages, hamlets, cultivated lands and factories. Factories, worked by water from forest streams, where the air seems as clear and pure as on the Alps. Above and all around, stretching over an apparently limitless expanse of rolling hills, lies the glorious forest, natural in its beauty, artificial in its productiveness. In the valleys are the spas, whither flees the German in summer as the Englishman to his seaside watering place. Few would hesitate which to choose if there were forests in England. Surely the æsthetic side of forests would have some influence on a not too artistic national character! I know of no reason why there should not be another "Black" forest on Dartmoor or Exmoor. Nor why we should not see in England that fair landscape of sea and forest that has rendered Knysna famous throughout South Africa. Is there any valid reason why many as fair a scene should not be reproduced in England to-day? It is my object in the following pages to submit certain facts bearing on this important subject, facts well worthy of earnest consideration at the present time. If England and the British Isles are to be restored to their former beauty and productiveness, reforesting is essential.

A quarter of a century spent in the administration of national forest estates in India and the Colonies enables me to affirm the proposition with some confidence, that the great want of England at the close of this nineteenth century is National Forestry.

State Forestry in England and Abroad; its Cost and Superiority to Private Forestry.

Let me at the outset clear the ground by saying that the forestry for which I plead is not the necessarily fitful efforts of a few private landowners, nor the founding of quasi-chairs of forestry at certain agricultural schools; but the national forestry of a powerful Government department, properly manned and officered with scientific men; a department which, with a million pounds sterling to spend yearly, should work steadily at the formation of national forests, in the sense in which this term is understood in most other civilised countries, but especially on the continent of Europe.

There seems to be a consensus of scientific opinion in England now that national forestry should be taken in hand as a national work, and prosecuted as a sacred obligation to posterity, as far above party politics as is the national credit and payment of interest on the public debt.

The way to this end is perfectly clear. Of all the means that have been tried in various countries, but one has given permanent results. A distinct branch of the public service must be formed. It must be gradually built up of professional forest men, specially trained and educated to their work at schools and universities, such as the Government of India now maintains at Cooper's Hill and Dehra Dun.

Forestry would have to be added to the curriculum at every technical school; then the spread of education would rapidly put an end to such a sad farce as the present state of the historical New Forest in Hampshire. There one sees nearly 100 square miles in the heart of fertile England, solemnly condemned by a special Act of Parliament, to perpetual waste and mismanagement. It is as if the Legislature were to itself attempt to treat an intricate medical case; a case, too, that requires a different treatment at every stage, and a treatment that must be gradually varied as skilled experience is gained.

It is difficult for the inhabitant of an inland country, such as the Transvaal or Switzerland, to realise all that is meant by the sea, sailors, fishermen, a navy, and naval men. I have constantly experienced the same difficulty in speaking to Englishmen of forests, forestry, foresters, and forest officers. To the average Englishman a forest is simply a collection of trees, at best badly grown trees. The English parks throw him off the scent. Speak to him of a forest officer, his mind runs to a park-keeper or gardener. Of all that is meant by a close, clean, high-timber forest; of its peculiar condition of soil and climate, its varied requirements and skilled treatment, he is as ignorant as is a Chinaman of electricity. There is not a forest scene by an English painter in the National Gallery, and very few by foreign painters!

I have in my hands the prospectus of a West Australian forest company, and the report attached of an unprofessional gentleman sent out to report on the forest. It contains an error sufficient to wreck the concern. Will it be believed that no expert literature in English exists on any of the Australian forests, vast though they are, and estimated to be worth many hundred million pounds sterling? In spite of the protests of an enlightened and far-seeing few, little is thought of but forest destruction, with or without some return in money. The wanton destruction of the unique Kauri forest in New Zealand is one of the saddest spectacles on this fair globe of ours. Kauri is a class of tree that will never be replanted; while the forest, as a whole, could be worked conservatively nearly as profitably as it is now being destroyed. Broadly speaking, when as a colonist the Englishman goes abroad he proceeds, like the Spaniard in Mexico, to destroy as a nuisance the forest that he encounters. He calls the forest "bush" in Australia and South Africa, and "jungle" in India. Timber was expressively christened "lumber" in America. As was justly observed by a recent eminent writer:—"In not one of the English colonies is the forest question seriously considered, if we except India and Cape Colony." A variety of circumstances led up to the conservation of the forests of India; the genius of one German (Sir Dietrich Brandis) founded the Indian Forest Department, the only complete organisation of its kind amongst English-speaking people. The Cape Forest Department owes its formation and usefulness mainly (I fear it must be confessed) to the fact that half of the European colonists at the Cape are *not* of English extraction. The neighbouring colony of Natal, the "English Colony" of South Africa, after the temporary employment of an able forest officer from the Cape, and an exceptionally good professional man from Germany, has now gone the way of other English colonies. Three-quarters of its rare indigenous forest is hopelessly destroyed, and the remainder, now under only nominal conservation, is fast disappearing.

Along with the training of a body of professional English forest men there would, of course, be required an annual vote for the formation and tending of the national forests. For many years the largest portion of this vote would be expended on formation, *i.e.*, in the planting and acquisition of suitably situated forest lands as these came into the market. In this way the national forest estates, the glory of generations of Englishmen yet unborn, would be gradually built up. The present low price of land in the British Isles offers exceptional advantages for the early initiation of such a scheme. France spends yearly somewhat over £500,000 sterling on its forests. Of this, about one-half is expended on forest officials and their education. In Germany relatively more is spent on forest work, as the wood is there felled by departmental agency and brought to the roadside. The total value of the German forests is reckoned at £900,000,000 sterling, capitalising at 2½ per cent. on an annual out-turn of 60,000,000 cubic metres, valued at from £20,000,000 to £22,500,000 (Prof. Gayer).

Coming to a British colony, the yearly budget provision for forest work at the Cape amounts to upwards of £60,000, which is somewhat over 1 per cent. of the total yearly expenditure of the colony.

If England were to re-forest at the same rate proportionately, 1 per cent. of the national

expenditure would represent an amount of about £1,000,000 sterling as the annual forest budget. If this sum were voted annually by Parliament it would suffice for re-foresting yearly about 100 square miles, or say the present area of the New Forest in Hampshire, taking planting and fencing at £5 per acre, and the average cost of the land purchased at £10 per acre. While much of the land required for re-foresting—sand, mountain, and moor—could be obtained at very low rates, other land that it is desirable to re-forest would cost £15 or £20 per acre. This is a work to be undertaken in the prosperous days of a country's history. The report of the recent Recess Committee on the establishment of a Department of Agriculture and Industries for Ireland estimated that to re-forest 3,000,000 acres in Ireland would cost £20,000,000 sterling. No doubt Ireland alone is capable of producing one-half the present importation of wood from abroad into the British Isles. The present per-centage of woodland in Great Britain and Ireland is 4 per cent.; while in Cape Colony, with its wide, treeless plains, forests cover only ¼ per cent. of the whole area. While some of the Colonies are in the position of having more forest than they want or than is desirable, the proportion of woodlands to open country represents in the mother country a miserably deficient quantum. If we look at the position of Great Britain and Ireland among the States of Europe it will be seen that in forestry it occupies the lowest place, standing below all the European States. It is even 1 per cent. worse off than Portugal. *In Germany 25 per cent. of the country is wooded.* This is the proportion that is considered usually desirable in a well-regulated country. The per-centage of woodlands in the British Isles would be raised by 7 if there were planted the 10,000 square miles or thereabouts required to produce at home the present importation of wood and forest produce from abroad. The following is the proportion of woodland in some of the more important European States:—*

	Per-centage of Woodlands.	
Russia in Europe	36	Scientifically conserved and permanent.
Austria	30	
Germany	26	
Switzerland	19	
France	17	
Portugal	5	
Great Britain and Ireland	4	Parks, small plantations, &c.

* Schlich and Nisbet.

France has one colony in a temperate climate comparable to the Cape and Australia—viz., Algeria. Here the Forest Department was inaugurated along with other branches of the public service as soon as the country was settled; and Algeria has to-day about 8,000 square miles of State forest managed by the Forest Department, about the same area which cannot for political reasons at once be brought under forest management, and a further area of about 1,500 square miles of private and communal forest, partially managed by the Government Forest Department. Altogether it is estimated that 5 per cent. of the area of Algeria is wooded.

Nearly one and a half millions are spent yearly on foreign missions. This expenditure is of a sacred nature, but so are trees to those who live in the forest and study its laws and well being. We want missionaries to go abroad amongst people who know not the forest, missionaries who should speak of its ennobling qualities, its beauty and its necessity on God's earth. It is a curious reflection that if a like sum were spent yearly in reforesting in Britain, the desecrated land would be restored to its former glory in three generations. Take one item, the rubbish heaps from the mines in Cornwall and the Black Country. A distinguished forest officer lately formulated a perfectly feasible scheme for afforesting these. I have not heard that any mining owner, wealthy though they mostly are, has yet planted an acre. A mine owner expects some better return than a doubtful 2½ per cent. on his outlay. Nor is he usually content to wait till his grandson's time for this poor and uncertain return. There is too often an element of uncertainty in the return from small private plantations. The State should do this work. Some one will object that the rubbish heaps are private property, and as such are sacred. Doubtless; but they are also a national eyesore. The Legislature should deal with them as the French do with their sand-drifts. If the owners cannot or will not afforest, let the State do it, retaining always the management by its own forest officers, but paying to the owner the difference between revenue and cost of management.

Similarly with municipal or other forests owned by any public corporation, such as a County Council. These must be managed by the Government forest officers to ensure the requisite continuity and stability in the operations. This proposition may sound bureaucratic and repugnant to English ideas of local

self-government; but it is a matter that has been thoroughly threshed out on the Continent of Europe, and the same conclusion arrived at by such differently complexioned States as Germany, Austria, France, and Switzerland. Corporate forests thus managed are but little inferior in condition and yield to those owned by the State. All net revenue is of course paid to the corporate owner.

Forests in Europe fall into three clauses:—

(1) Those owned and managed by the State.

(2) Those owned by corporations, but managed by the State.

(3) Those owned by private individuals.

Forestry in England is in the peculiarly unfortunate position of only being represented by usually ill-managed woods of the third class. No useful purpose would be served by attempting to palliate this fact, or by citing brilliant exceptions to the contrary. The planting in the Scotch Highlands should receive public recognition. I have heard of a landowner in South Wales who has planted 10,600 acres of larch, and of a large English landowner who has obtained the services of a German expert to draw up a scientific working plan for his woodlands. Such exceptions cannot in the nature of things last long. There is rarely a guarantee that they will last beyond one lifetime. It would be one of the functions of national forestry to assist private forest enterprise in every way; not to supplant or forestall it. State forests worked at long rotations would supply the large clean timber now imported from abroad. Private forests, on account of the necessary length of rotations, cannot do this; they would continue to supply pit props, poles, sleepers, and special timber, such as figured ash, hedgerow elm, &c.

Compared with State forests, private forests are at a disadvantage on these three points:—

(1) *Changing Ownership.* — The careful landowner may have a spendthrift son, or one of different tastes. The estate may have to be sold for various reasons. This usually entails a rupture of the working plan, together with the scientific working of the woodlands.

(2) *Interest on Borrowed Capital.*—The State can raise loans at 2 per cent. interest. The private forest owner would have to pay double this, or more, on the uncertain security of a private forest.

(3) *Cost of Management.*—A large forest estate can be more economically managed than a small one.

Thus we arrive at the curious fact (in sharp contrast to the general position) that forests are better and more profitably worked in the hands of Government than by private owners.

The assistance rendered by Government to private forest owners in Europe (and latterly America) takes the form of grants of young trees free, or at cheap rates; advice in drawing up working plans; and last, but not least, the example, which is better than precept, of scientifically managed forests yielding good returns dotted throughout the country.

Imported Wood and the Area Required to Produce it in England.

England imports practically the whole of her wood—a necessary of life. This is in itself a bad position to anyone but a rabid free-trader. Worse than this, though, foreign supplies are becoming exhausted. Wood must rise in value, and taking a century or more to produce, timber forms an exception to the ordinary laws of supply and demand. The time is not far distant when every civilised country will want all the wood it can produce. Germany, Austria, France, and Switzerland have scientifically managed national forests, but these will not do more than satisfy their own requirements in the future.

The timber and forest produce imported into the British Isles, and that could be produced equally well in this country, represent a value of about £20,750,000 sterling.

Importation of Wood Producible in Britain.—The last returns published by the Board of Agriculture give the following figures for 1896:—

Fir	£16,000,000
Oak (including staves)..	1,500,000
Various	1,649,000

If we take one-third of the last figure as producible in Britain, we have a total of £18,000,000, for imported timber producible in Britain. This is exclusive of nearly a million's worth of manufactured house and furniture wood, of which nearly the whole comes from Europe or North America, and is producible in England. It is exclusive, also, of £1,750,000 for wood pulp; of tar (mostly Russian), £74,000; rosin, £419,000; turpentine, £490,000 (both nearly all from U.S.A.); or home producible timber, rough and sawn, £18,000,000; manufactured, £1,000,000; forest produce about £3,000,000, of which £1,750,000 for wood-pulp is certainly producible in Britain: total timber and produce, certainly producible in England, £20,750,000. A curiosity of forest produce importations is £114,000 for moss and forest litter.

At ordinary rates of yield this would require about 9,000,000 acres for its production—9,000,000 out of 77,750,000 acres, the total area of the British Isles. This is not quite 1 acre of forest to every $8\frac{1}{2}$ acres of open country. Germany has 1 acre of forest to every 4 acres of open country.

Compare this £20,750,000 with £25,000,000, he pre sent cost of the National Debt. Our forest improvidence costs us nearly as much as our National Debt !

The question as to the quantity of land available for reforesting in Great Britain and Ireland is discussed by Dr. Schlich in his admirable "Manual of Forestry," of which the final volumes have been recently published. And his conclusion is that the moors, mountain land, and waste land generally, added to the area which is at present more or less imperfectly wooded, are large enough to yield easily all the timber and forest produce now imported. The Recess Committee a few years back reported that Ireland alone has 3,000,000 acres available for re-forestation. Geographical text-books tell us that one-fourth of the area of England is waste, *i.e.*, neither arable nor permanent pasture land, and that in Wales not much above half the land is in pasture or under cultivation; while in Scotland only about one-fourth the area is arable. Ireland, like England, has about one-fourth of its area waste, *i.e.*, neither cropped nor meadow land. Altogether, the cultivable area of the United Kingdom is little above one-half the total area, 58 per cent., thus leaving ample room for forests.

Recently, when discussing the forest question with a prominent member of the present Government, I was met by the assertion that the British Isles are too densely populated to produce at home the present sea-borne timber. This, however, though a common popular error, is far from being the case. Only to cross the channel, there is the example of Belgium with a denser population than England and better forest. Indeed, it may be useful to glance briefly at what Belgium, with a population the densest in Europe, is doing to improve its forests.

Belgium pays nearly £3,000,000 for imported wood, and produces £4,000,000 worth yearly from its own forests. Strong efforts are being made to improve the forests and reduce the imported wood. A considerable sum is set apart every year by the State for the acquisition of waste lands or ruined forests; and it pays one-third of the cost of planting up large areas of village waste for the benefit of the communes concerned. There is a Central Society of Forestry, consisting of 900 members belonging to all classes, from the King and his Senators down to small landowners and their agents and even tradesmen. The society endeavours to spread a due understanding of the objects and benefits of sylviculture by means of a journal, by public conferences and trips to the forest, and by free advice.

But Belgian forest work is quite recent. As late as 1884 the forests were being mismanaged and alienated. Shortly afterwards an independent forest administration was established under a director, and in 1893 the "Conseil Superieur" was added. This consists of at least twenty-four members, representing different districts, and competent to advise on all forest questions. In 1895 the game and fishing laws were brought under the forest administration. The forest area of Belgium comprises: public, about 500,000 acres; private, 1,250,000.

The private forests are thus about one-sixth the total area of the country. Belgian forest officers were formerly trained at Nancy or Tharandt, but they are now put through a three years' course in Belgium.

The areas that suggest themselves for extensive reforesting operations within the British Isles are the mountains of Wales, the English Lake Country and the Scotch moors and Highlands; the "downs," so common everywhere; together with the wolds and other areas where the forest has been destroyed in recent times—the Yorkshire and Lancashire Wolds, the Cotswolds, the weald of Kent. (The word *wold* comes from the Anglo-Saxon *weald*, and is the same as *wald*, the modern German for forest.) Then there are the now barren and almost waste English moors; desolate Exmoor; the wet tor-crowned tableland of Dartmoor; the bleak Yorkshire moors; the peaty Lancashire moors, also the bogs of Ireland. The reforesting of the moors and bogs would not be so easy as work on the mountains and wolds. With the destruction of the forest has gone the rich forest soil and forest drainage. Much of the reforesting of the moors and bogs would have to be left to the gradual operations of nature, neighbouring plantations affording shelter, drainage, and seed. Darwin, Ruskin, and various English writers speak of the wonderful power possessed by Scotch pine of gradually spreading itself, self-sown, over adjoining waste lands. Cluster pine has the same power in the more temperate fertile parts of South Africa.

But, wherever possible, wherever the price of land be not too high, the future State forests should be located near the great centres of population, on account of markets and the bulky nature of wood and woody produce; for the health and recreation of the people; and, as regards London and other important centres, for defensive purposes. Consider the beautiful forests in the neighbourhood of Paris.

Decline of British Agriculture met by the Rise of British Forestry.

Looking into the future, although little encouragement is discernible for British agriculture, for British forestry the prospects are brighter. The present low price of English timber need not be seriously considered. Its inferiority is admitted on all sides. Its exclusion is specified or implied in nearly all building contracts. Till lately it was legally excluded for building timber under the Lands Improvement Act. British coniferous timber is used only for rough work and is too often a drug in the market. This inferiority has nothing to do with climate. It is solely due to bad forestry. The German and French forest officers who have visited England tell one tale; and there is not a shadow of a doubt on this point, that good forestry in England would produce timber equal to any that could be imported. To a forester this is so certain that it need only be mentioned here. A more important point to consider is the diminution, in the future, of supplies from abroad and, the consequent increased demand for home-grown timber. Here English forestry could not wish for better prospects. The vast forests of North America are disappearing by leaps and bounds. Though much has been written and said about forest conservation, only a beginning has been made in the reservation of the national forests. It is more than probable that forest destruction fn North America will not be arrested until no more forest is left than is required for home consumption. The forests of Russia are in similar case. The same may be said of the forests of Sweden and Norway which are largely in private hands, and are going the way of private forest all the world over. The forests of central and northern Europe will not in the future suffice for more than local demands. As regards competition with home timber, tropical forest, and the forests of the temperate regions in the southern hemisphere, may be left out of account. They may send a little hard wood, in spite of the distance, to compete with oak, and for special uses, such as street paving; but remembering the fact that about $\frac{9}{10}$th of all the wood used in civilised countries belongs to the pine or the coniferous class, and that the supplies of this wood come, and must come, almost entirely from the cold temperate regions of the northern hemisphere, it will be seen that English forestry has in the futnre little or nothing to fear from foreign competition.

Compared with English agriculture English forestry has these two further advantages:—

(1) *The Bulky Nature of Forest Produce.*—Wheat, frozen meat, fruit, skins, &c., can be brought at moderate expense from the Antipodes. But long carriage by sea or very short carriage by land soon renders the cost of imported wood prohibitive. Rafting such as one sees on the Rhine and on the Baltic rivers is out of the question in the temperate regions of the southern hemisphere. In the tropics the rivers are usually fitful, being dependent on heavy periodic rains, and though of course there are navigable and raftable rivers, the number of these in proximity to workable forests is not great. There is the further difficulty in the tropics that most of the woods are too heavy to float and require to be buoyed up with bamboos.

(2) *Cheap Money.*—The low current rate of interest on loans has a beneficial, but only a comparatively small influence on agriculture, where some return on the capital invested is usually obtained within a year or two. In forestry, owing to the long-deferred yield, a low rate of interest on money is an all-powerful favourable influence. Forest estates rarely yield more than 2½ or 3 per cent. The produce per acre runs into big figures, both of yield and money, but the length of time required to obtain this yield reduces to 2 or 3 per cent. the interest on the capitalised value of the estate. The public funds have now sunk to a lower rate of interest than that yielded by forest estates. Consols to-day yield only 2 per cent. I can remember the time when 5 per cent. was usual, and was considered a fair rate of interest for safe investment in England. Five per cent. has since gradually fallen to the 3 or 2½ per cent. of to-day. This steady fall in the current rate of interest on capital, and the equally steady destruction of extra-European forests combine to render British forest estates in the future a more remunerative investment. The fall in the rate of interest tells most in favour of State or national forestry, because (1) it is the State that is chiefly concerned in the production of large timber at long rota-

tions; (2) it is the State that commands money at the lowest rates of interest—to-day 2 per cent.

Thus, although forestry and agriculture are at present in an equally depressed condition in Britain, the prospects of forestry in the early future are as bright as those of agriculture are sombre.

The present bad quality of British timber is solely due to bad forestry. Foreign wood must become dearer, and gradually rise to famine prices. The cost of transporting a bulky material such as timber must always tell largely in favour of home produce. The fall in the current rates of interest on capital renders British State forestry remunerative to-day, for the first time in history.

The Rural Population Benefited by the Rise of British Forestry.

Land in the British Isles is going steadily out of cultivation; the rural population, the backbone of the country, is steadily declining. To a visitor absent for many years from England, this is quite the saddest feature of modern developments.

As compared with pasture the area under crops in the United Kingdom is an ever-diminishing quantity. In Great Britain about one-half the arable land is under crops. In Ireland there is little more than one-sixth. Though this decrease of cultivated land may represent a small economic gain in the increase of England's unique grass lands, the loss of rural population has a serious national aspect which can hardly be qualified otherwise than as a national disaster. In this statement I think I have with me all those who have seriously studied the population statistics of these islands. To remedy this serious and growing evil there occurs nothing so practical as national forestry.

Dr. Schlich calculates that if the 9,000,000 acres required to produce the present forest imports, were to be planted at the rate of 300,000 acres yearly, at least 15,000 labourers, corresponding to a population of 75,000 people, would be employed; and that at the end of thirty years, when the 9,000,000 acres had been fully planted up, permanent employment in the forest would be given to, say, 150,000 labourers, representing a population of 750,000 people. A further large rural population would be provided for by the various forest industries attendant on the formation of forests. I have in my mind a prosperous German hamlet following the happy thought of one man (and he a peasant) to plant osiers. In Germany it is estimated that the wages of people employed on forest industries amount to something like £30,000,000 sterling, and that roughly 12 per cent. of the total population of Germany is employed in the forest and out of the forest. About 1,000,000 people in the forest, *i.e.*, directly employed in working the forest estates, and about 3,000,000 out of the forest, *i.e.*, in working up forest produce, chiefly timber, into the various articles manufactured from wood.

Certain forests are maintained in Germany for the support of certain industries. Without the forest the industries would exist with difficulty, or go to some other country. The Spessart forest is a case in point. Here is a fine old oak forest deliberately worked by the Bavarian Government *at a rotation of* 300 *years*. Of course, with such a long rotation there is an enormous sacrifice of interest on the capital locked up in these old trees. But the trees are Durmast oaks of slow growth and very fine grain. A regular supply of this wood is necessary to the well being of important industries in the villages around. So far has the State conservation of these trees been carried that some of the trees now being gradually and methodically worked through are as much as 450 years old. The plan of operations, technically termed the "working plan," was framed in 1888 and runs to the year 2007.

As customary, the whole forest has been made the subject of close examination and careful calculation by a special commission of forest officers. Starting with the postulate of a sustained yield, they have laid down how and when each group of trees is to be felled, up to the year 2007. The very old trees—too old to have any volume or value increment, might now be sold (says Sir D. Brandis in a recent review in "Nature") for about £150,000.

It will at once be said that the maintenance of such trees is utterly opposed to modern principles of political economy. Quite so. The loss of interest on the oldest of them costs Bavaria £27,000 a year. But German public opinion rightly considers that the forests and village industries are worth this, and more also.

Physical Degeneration of the Race.

The prudent foreigner, looking across his wooded mountains, will tell you that England is rich and can well afford to pay in the future for her present forest improvidence. There is

more than this in the forest question, and to my mind it is quite the saddest aspect of it.

Great Britain now pays about £20,750,000 annually for imported wood and forest produce that could be produced equally well in the British Isles. Broadly speaking, this wood is paid for by manufactured goods produced by the labour of the factory operative, that physically degraded type of humanity one sees in all big manufacturing towns. With the destruction of the forests in England have gone the stalwart men who once worked in them; to be replaced by the factory hand—weak-lunged, knock-kneed, and sallow. One has only to travel through the forests of the Continent of Europe and then visit a few of the large manufacturing towns of England, to have this physical degeneration of the race brought home in the most forcible and unpleasant manner. The wood industries are mostly healthy (to a great extent out-of-doors) occupations, and they usually employ a robust country population living partly on the forest and partly on their gardens and small agricultural allotments. But let us consider the one million people that in Germany live and labour in the forests. What a reserve of national strength! They are fairly, most people would say sufficiently, educated; and their healthy life in the open air and constant exercise preserves a physical development, a strength of frame and constitution, that is rare in these days of machinery and easy chairs! Judging from what I saw at a recent visit to the forests of Germany and the big towns of England, I should say that England could better afford to pay £20,750,000 for foreign wood than to lose the broad-shouldered and muscular men who once worked in her forests. These are the men whom we value as colonists—men fitted to go forth and subdue the waste places of the earth.

Not long ago an old Cape Colonist remarked that the Englishman of to-day was only fit to drive a steam-engine. From a certain point of view there was truth in the remark, and no doubt the steam-engine has had something to do with that degeneration in the frame and sinews of the race that is sufficiently remarkable. Town life and modern athletics are producing—at least, so it strikes an "Uitlander"—a small race, sprinkled, doubtless, with a per-centage of active, wiry men. But the big men of square frame and massive strength are increasingly rare. Few inquiries would be more interesting than a comparison of the average muscular power of the men and women of to-day with, say, Edward III.'s archers. How small a per-centage of English women nowadays know aught of healthy out-door labour. One is immediately struck by the difference on going to Scotland. The modern English woman considers out-door labour in the field and garden a disgrace. Just as the effeminate clerk looks down on the artisan, so does the sickly, shrunken household drudge on her brawny sister of the field—would I could say, and forest. The charm of Hardy's shapely "Tess" lay in her old-world out-of-door life. The graceful, shapely Kaffir woman loses her form and amazing constitution when she adopts English habits and ceases to labour in the field.

It is a curious fact, and one that affords food for much reflection, that the European who came to South Africa 200 years ago is, in frame and bulk, the physical superior of the average European of to-day. In spite of a warm and somewhat enervating climate, he has escaped the dry rot of town life. Put him to work in the field with the German or Italian peasant, and he is soon distanced. Put him behind the counter. He is not smart. But stir him up with an average European crowd, and his sturdy build betrays him at a glance.

Thus we see that national forests have an important bearing on national health and the physical degeneration of the population. To the town-dweller, national forests will supply public parks and recreation-grounds; to the countryman a means of livelihood in the country.

Forests as Recreation-grounds.

The national forests contemplated above, viz., 9,000,000 acres required to produce at home the timber now imported from abroad, would amount to an average area of about one and a half New Forests to each county. These would be national forests, and, in every sense of the word, national playgrounds; as are the national forests on the continent of Europe. Such forests spread over the length and breadth of the land would be the pride of every county. As public property they would be open to everyone, for everyone's use and enjoyment. Their important bearing on the health and enjoyment of the community needs no comment.

Let no one take fright at the mention of the New Forest. The management has been compared to that of a pilot endeavouring to sink his ship, and if one may believe what has recently appeared in the public prints, there

may be a good deal of truth in this playful comparison.

In any system of national forestry the State forests would be entirely free of those servitudes that have been allowed to grow up and nearly ruin the New Forest. There would be no walled-in enclosures, no part of the forest where every one could not go and enjoy God's earth in its wildest and most beautiful aspect to his heart's content.

Military Aspect. Forests a Means of Defence.

It is certain that forests in England would assist defence in case of invasion. In a forest disciplined troops are at a disadvantage. This has been seen in every Kaffir war in South Africa, only too sadly in the fighting with natives more recently in the Matoppa Hills. In the Perie forest a handful of ill-armed fugitives kept at bay a powerful English army well found in artillery and native auxiliaries. Here discipline was not only useless, but worse than useless. In the forest the colonial irregulars and native levies had actually to fight for and to protect the regulars. It is chiefly from behind cover that the Boer marksmanship is described as being so wonderfully accurate. The ancient forests of Britain gave Cæsar as much trouble as the ancient Britons. Forests played an important part in the American war of independence. It was largely by their aid that the raw colonial levies beat back the best disciplined soldiers of England. It is unnecessary to multiply examples. History is full of them. Forests, especially when the defenders have with them men who know the forest, always assist the defenders.

We have seen above that a scheme of national forestry would give employment to 150,000 men in the forest. No doubt these would be incorporated into a militia or volunteer corps for national defence. It is easy to see how invaluable such a corps would be in case of invasion. With a forest and foresters in every county, Great Britain would be studded with well-garrisoned fortresses. Forest, in these days of sharp-shooting and accurate rifles, helps the defenders far more than in Cæsar's time. The foresters in France and Germany form a valuable military adjunct, where every man is trained as a soldier. How much more would they be worth here where, in case of invasion, every disciplined man able to shoot, march, and camp out, would be at a discount. A forest militia, too, would help the solution of that difficult military problem, what to do with the army reserve men.

No doubt the navy is our first line of defence, no doubt the people would rise as one man if invaded; but no prudent man would wish to see this wealthy country with only one line of defence ready. Consider the rich prize of London, the possibility of a naval reverse and a dash on the metropolis. There has been no naval conflict between first-class powers with modern ships and guns. Here is an element of uncertainty. A large proportion of our seamen are soaked in malaria contracted on tropical service (notably the moral slave-hunting fad on the east coast of Africa, and the immoral gin protection on the pestilential west coast). Malaria never quite leaves the subject. It lurks in him, and is liable to prostrate him at any crisis involving unusual fatigue or exposure. Our malarial seamen would be unfairly pitted against non-malarial seamen. Then again the elements are proverbially fickle. Storms might interfere with our torpedo destroying arrangements. Two or three "mill pond" days might land an enemy on twenty points of our coasts. Every consideration of prudence demands a second line of defence *always ready* behind the navy. In the Franco-German war the Vosges mountains and forests were France's second line of defence, but the French were not ready to defend them and the Germans took them at a rush. In the last Russo-Turkish war the Balkan mountains and forests were Turkey's second, and for long successful line of defence. Could the small regular army maintained in England cope with a sudden invasion at twenty different points? We doubted this in Napoleon's time. With the present huge continental armies and their growing navies there is still more reason to doubt it now!

It would seem advisable therefore to incur some comparatively small extra expenditure on a forest militia and the grouping of the national forests so as to form a second line of defence round vulnerable or strategic points. Thus London would have its cordon of forests and forts. Part of the extra cost of land near London could be set against the gain to the population of such grand national recreation grounds.

Game.

Game and the fortuitous value it gives to waste and otherwise unproductive land has long been held to be an obstacle to forestry in Britain.

It was game that depopulated the Highlands of Scotland, and drove to Canada and elsewhere a race of men and women that should have been nurtured at home. Britain is the poorer for their loss, but Londoners have been saved the trouble of going abroad for their deer shooting, and our Highland regiments are recruited in Glasgow!

As regards game and forestry, I do not share the opinion of those who consider game and game-rents such a serious obstacle to forestry in the British Isles. The private landowner will prefer game to forestry because it pays him better, or, at any rate, sooner; but the private landowner is not of much consequence in forestry. His forest, as a rule, is badly managed, and in process of disappearance. Certainly, there are brilliant exceptions to this rule, in the Scotch Highlands themselves and among the German princes; but the general rule is undoubtedly true that in any scheme of national forestry the private forest is not of much account.

It is probable that in large national forests the loss of the present game rents would be little felt. Large game, such as one has in Germany, would come in with the formation of extensive forests. Wild boar, deer, and capercailzie would replace the grouse, barn-door pheasants, and battues of to-day. I doubt whether even the balance at the poulterer's shop would, after a few years, be much to the bad. To the true sportsman the change would mean a return to more genuine sport. Nowhere is game more keenly and successfully preserved than in Germany.

National Forestry should be Undertaken now as a National Insurance.

Scientifically-managed national forests would yield a per-centage return on their cost higher than the present rate of interest on Consols. In other words, such national forests could be formed to-day at a profit, and they would hereafter represent a perpetual and permanent source of national wealth. The wealth and strength that Germany draws from her forests are astonishing. One passes through villages where the people live free of rates and taxes, with perhaps a spacious school-house or public library thrown in. All this "comes from the forest," they tell you. The German forests, as we have seen, are valued at nearly £900,000,000 sterling.

A country's forests rank with its soil, rainfall, population, minerals, accumulated wealth, and other assets, to raise or lower it in the scale of nations. The mineral wealth of England is being rapidly worked out. It cannot be restored. The forests have been worked out, but they can be restored. It seems difficult to imagine any point in the country's history more favourable than the present for restoring the forests. So good is the national credit, that money can be borrowed at 2 per cent. In the total tonnage of its shipping England bulks half as large again as the other eight great Powers combined. Other countries pay Englishmen about £100,000,000 yearly as interest on loans. The financial position of England is to-day supreme.

It would be unhistorical and foolish to imagine that this supremacy can always last. Germany, America, and perhaps Japan seem advancing more rapidly than ourselves. It is possible to imagine them overtaking us, underselling us, outbidding us. Now, in the days of our financial supremacy, is the time to restore the forests, to effect a national insurance against less prosperous times. To restore the forests would be to make the soil of Britain worth more by £150,000,000 or £200,000,000 than it is to-day. Trade might seek other channels, minerals become exhausted, the populace decline in energy and strength, the colonies fall away, but the forests would remain an unfailing source of national wealth, a livelihood for a large part of the physically best part of the people. We are paying off the national debt, we encourage national thrift in the Post Office Savings Banks, the growth of life insurance is remarkable; but national forestry is looked on as unnecessary. Is England to follow in the footsteps of Spain, Italy, and Greece, where the forests were neglected in prosperous times, and the people had to take to hovels as soon as they became too poor to pay for foreign timber. Their deep poverty prevents them restoring their forests now, though they are fully alive to the necessity of doing so, and the loss of their forest enhances their poverty.

Germany, Austria, France, and Switzerland have their national forests scientifically managed. Britain, alone among the great Powers, allows this vital question to sleep. The sooner the position is realised the less will be the cost of retrieving it, since we are paying yearly £20,750,000 for foreign wood that could be equally well produced in these islands.

Lastly, when considering forests in the light of a national insurance for England, there is the curious fact that along with England's financial supremacy has come agricultural

depression and the fall in the value of agricultural lands. These two facts taken together indicate the present as a unique period in English history for inaugurating national forestry.

Cost and Yield of National Forests.

In considering the returns to be expected from national forests it is easy to get astray in matters of detail. It would be unsound to generalise from figures drawn from private forests. It is particularly unsafe in the case of plantations, where the conditions vary so largely. Cost of land, cost of young trees, cost of fencing, the market, are necessarily very variable items in each case. We may learn that the very best land for planting in Scotland may be had for 50s. per acre, and that it can be fenced, drained, and planted for £4 per acre, that some plantations in Scotland are scarcely paying expenses, that other Scotch plantations are yielding fair returns, that larch plantations in South Wales are paying handsomely for pit props, that good agricultural land in England is rarely obtainable under £20 or £25 an acre, and is commonly worth £60 or £100 per acre, and there is sandy but good planting land to be had in Surrey for £8 an acre. On the whole, we may, perhaps, assume an average value of £10 per acre for the land required for reforesting, and £5 per acre for planting, fencing, and draining. Thinnings would have little value in remote localities. Near London and centres of population every stick would be marketable. Approximately, and on an average, we might assume that the value of the thinnings would cover the cost of administration up to the epoch of the principal cuttings.

The returns for 1896 give the value of imported timber producible in Britain as over £20,000,000. Let us consider what would be the cost and profits of planting 10,000 square miles, calculated to produce about £12,000,000 worth of timber annually.

Let us assume an annual vote of £1,000,000 expended in buying ground, fencing, draining, and planting 66,666 acres, or 104 square miles yearly at £15 per acre. This is calculated to yield timber and forest produce worth about £13,000,000 now, and, say, £16,000,000 in 73 years. Let us assume a rotation of 73 years. An expenditure of £1,000,000 now, would, at 2 per cent. compound interest, quadruple itself in 73 years. In 73 years, therefore, the capital of £1,000,000 would amount to £4,000,000. Thus on a 2 per cent. basis, with an expenditure of £4,000,000, we obtain timber worth £16,000,000.

If we assume £8,000,000 as the net value of the wood in the forest, that leaves a profit of 100 per cent., or (looked at another way) a return of 4 per cent. on the capital; but in any case the whole £16,000,000 would be spent in this country on the wealth and health of its people.

To reproduce the woods after the first rotation, natural reproduction would no doubt be largely employed; and the value of timber tending to rise, and consols to fall, the national forests would probably yield 5 or 6 per cent. at the next rotation.

The German forests actually return now from $2\frac{1}{2}$ to 5 per cent. on their capital value.

Abatement of the Smoke Nuisance.

One of the results of national reforesting in England would be an abatement of the smoke nuisance of towns. Let anyone compare the thin blue smoke, almost vapour, from a wood fire with the dense black sulphurous smoke from a coal fire. No doubt the smoke from wood fires varies much, and some forms of coal burn almost without smoke. If, however, we consider the average combustion of clean, well-seasoned firewood, and ordinary descriptions of coal, there is a vast difference in favour of wood. For many years I have held that herein lies the chief key to the difference between clean, bright Paris and grimy London. About 25 per cent. of the country round Paris is wooded. Consider the fine forest of St. Germain within ten miles of Paris.

If London were in such case, the necessary thinnings from the forest would furnish the poor with a firewood cheaper and more wholesome than coal, while in the dwellings of the rich, wood would be preferred on account of its cheerfulness and freedom from dirt. No doubt, to get sufficient heating power from wood, it would have to be used as it is on the Continent in suitable stoves. These may be close with great heating power as in Russia and Germany, or open, as in Belgium and parts of France. In either case there would be a great gain of heating power over the present dirty open fireplaces. No doubt it is the combination of watery vapour and smoke that produces London fogs, and that the condensing watery vapour, especially during winter, must always be present in London. But I am convinced that the substitution of wood fuel for coal would give London a greatly improved atmosphere.

Reasons against Delay.

Let us briefly recapitulate the reasons against delay:—

1. £20,750,000 spent every year for wood that could be equally well grown at home.
2. Consols at 2 per cent.
3. Shrinkage in foreign sources of timber supply.
4. Fall in the value of land in Britain.
5. Livelihood for the country population.
6. Recreation for the towns' folk.
7. Aid in defending the country against invasion.
8. National insurance.
9. Abatement of smoke nuisance in towns.

It may be objected that much of what is here set down has been heard before. Private forestry and its failure in Britain is no new story. But I do not know that the claims of national forestry have ever received the consideration they now merit, nor indeed could they. It is only within the last few years that the financial position of national forestry has become assured. When I studied in the forest schools of Europe a quarter of a century ago, national forestry for England was not possible as a paying concern. To-day the country can borrow at 2 per cent. National forests will return 3 per cent. and upwards.

Pondering these things, the conclusion to a Colonist and a forester is irresistible. England's great want at this time is national forestry. And as one reckons up the gains—£20,000,000 more produced yearly in the country; 750,000 people kept on the land; a forest playground for every man, woman, and child, with a fostering of the love of nature and the beautiful; less smoke: when one considers that this can be produced at no final cost to the public exchequer (probably a considerable gain), and that for a moderate extra cost we obtain strategic forests and a defensive forest militia—pondering, I say, these things, the strange puzzle of the present position becomes stranger and stranger.

DISCUSSION.

The Secretary read the following letter from General Michael:—

Bangor Lodge, Ascot,
18th Nov., 1899.

Dear Sir Henry Wood,—I greatly regret that, by medical advice, I am laid up, and unable to preside at the Society's meeting on the 22nd. It is a disappointment to me, as Mr. Hutchins, although serving at the Cape, is an officer of the great Indian Forest Department, to the success of which the Cape, as well as many others of our colonies, are indebted for the existence of the conservancy departments they now possess. I have seen a proof copy of Mr. Hutchins's excellent paper, and I need not say that I fully endorse his views as to the need of State action towards creating national forests, scientifically administered, in the United Kingdom, as well as State aid towards the better education of the foresters, of all grades, who are so urgently needed throughout the country. In a paper which I read before the Society of Arts, on the 19th December, 1894 (published in the *Journal* of the 21st December, 1894), my views on these points were fully stated. I also made some suggestions as to the manner in which State aid might be given, and after contrasting the inaction of England with the energy of other countries, I concluded with the following words, which I now venture to repeat:—"We have reviewed what most of the nations of the world have done for forestry: is it not sad and humiliating that the United Kingdom alone hardly lifts a finger to further a science which is of such immense and far-reaching national importance?"

Yours sincerely,
J. Michael.

Sir Joseph Fayrer, Bart., K.C.S.I., F.R.S., said he had no practical knowledge of forestry, but he had seen something of the good results obtained in India by its operation under the direction of many able and distinguished men. He must confess to some disappointment at seeing that whilst the work of the eminent men who now directed the Forest Department of India was fully recognised, it seemed to be forgotten that the two fathers and pioneers, he might say the creators of the Indian Forest Department, were left unnoticed. He regretted to say that one of them, Dr. Cleghorn, was no longer living, but General Michael remained, and his services were still unacknowledged. They were acknowledged occasionally at private meetings, but General Michael had never received that public recognition for services so great and important that he might safely assert that they owed the present forest system of India, which was the best in existence, to his initiation. When General Michael was made Director or Conservator of the Forests of Madras he was not the first who had dealt with the subject. Dr. Gibson, of Bombay, and others, had for years been working at it, but their efforts, however good in themselves, failed politically and financially, and it was not until General Michael was made Superintendent of the Anamalli forests that the practical value of many of the woods was made known, and the administration was worked at a profit instead of a loss. Unfortunately, after some years service, he was compelled by ill health to come to England, his name was removed from the roll of the Department, and he did not return to

the appointment which he had held to such great advantage. He was succeeded by Dr. Cleghorn, who perhaps managed the Department in a more scientific way, but not with greater success, and he in turn was succeeded by that most distinguished scientific man, who had justly earned the respect and admiration of India, Sir Dietrich Brandis, who was again followed by the very eminent men who had since occupied the post. He was very sorry not to see General Michael there that evening; but he was thankful to say that the operation to which he had submitted had been most successful, and there was every prospect of his speedy recovery. The paper was very practical and pointed. It was well that we should be told the plain unvarnished truth—that we were wasting our forests, squandering our national wealth, not preserving what we could, and pretending we could not produce timber, when this paper proved that such was not the case. We might produce much of the wood for which we now paid so dearly, and with great advantage to the health and prosperity of our people. The advantages of forestry to India were immense. There were parts of that country now where streams of water were absorbed in the sand, which at one time were covered with trees. The Hindoos knew the value of trees; one of the first duties inculcated by their teachers was to plant a tree. The great sub-montane district of the Himalayas, called the Terai, was, as its name implied, a moist district, and there was a good growth of trees there. It was true there was a great deal of malaria, but there was much else which was very valuable. The water did not rush down in devastating torrents; it gradually filtered through the roots of the trees; and the foliage brought rain where it would not have fallen otherwise. Parts of Scinde were the most desolate in India; properly speaking there was no rainfall at all, or not more than an inch; but since Colonel Jacob—another man whose name should not be forgotten in this connection—planted trees there, they have had a rainfall. Those who had been through the Suez Canal knew how very little rain primarily fell in the district; but on the sides of the canal you can see the grooves down which the rain water now trickles, which was in consequence of a certain amount of forestry which had taken place even there. Vegetation had been produced, and rainfall naturally followed. They were much obliged to any one who spoke the plain truth, authoritatively and scientifically, however much it might be opposed to popular methods.

Dr. Schlich (Cooper's Hill) remarked that whatever might be said about the paper, nobody could accuse the author of not being bold enough; for he asked the British Parliament to spend £1,000,000 sterling annually on afforestation; with the expectation of getting great results, some of which he had described. Ever since he (Dr. Schlich) came from India in 1885, he had been labouring on the same lines, endeavouring to show the uncertainty of the present supply of timber, and how the prospective falling off must be made good. Our net imports now were below 8 and 9 million tons per annum, to a value of from £18,000,000 to £20,000,000 sterling. Last year he read a paper before the Imperial Institute on this question, and since then he had gained further information, which confirmed the views he then expressed, which were quite in accord with those of Mr. Hutchins. He spoke of the United States soon requiring all the timber they had; but in fact that period had been passed some time. For some years that country had imported more timber from Canada than they exported. In 1889, 61 per cent. of the Canadian exports of timber came to the British islands, and 39 per cent. went to the United States; in 1894 the position was reversed: Great Britain got 40 per cent. and the United States 60 per cent.; and the same process had been going on since. The demand for timber in the United States was so great that in a few years they would take all the Canadian supply and none would be left for England, which now got 2,000,000 tons per annum. Of the other 8,000,000 tons imported in Great Britain, 5,000,000 came from the Baltic; 2,000,000 from Russia; 2,000,000 from Sweden; 700,000 tons from Norway; 300,000 tons from Germany, or 5,000,000 in all, and of that 95 per cent. was coniferous timber, and 5 per cent. hard wood. We need not trouble about the supply of hard wood for many years; there were large quantities in Africa, Australia, the West Indies, Brazil, and other countries; but if the supply of light handy easily worked timber fell short, it would be nothing less than a calamity; and that calamity was much nearer than many people thought. Of the Swedish forests 80 per cent. belonged to private owners, and only 20 per cent. to the State; of the Norwegian, only 12 per cent. were State forests; of the Russian forests, which were enormous, 60 per cent. belonged to the State. It had been noticed that the size of the timber received from the Baltic countries was slowly but steadily decreasing, which meant that the old giants of the forest had been gradually disappearing, and bit by bit smaller timber had to be cut. Of late years an enormous industry in the mannfacture of wood pulp had sprung up in Sweden, and, unfortunately, in that manufacture small-sized timber was required, and thus an enormous number of young trees which ought to be left to grow up were converted into pulp. He had lately gone through a large volume on the forests of Russia, and found that though the nominal area was enormous, there were large portions which had but very little timber, and other large portions which had only small trees, so that practi cally the extent of the forests was far less than it appeared. Germany had just about enough timber for her own use 15 years ago; she had then 34,000,000 acres, about 20 per cent. of the total

area; the exports and imports about balanced. The returns for 1898 showed that the net import of timber into the German Empire were 4,325,000 tons, value £12,000,000; or about half the quantity and two-thirds the value of the imports of Great Britain. Of this, 1,800 tons came from Russia, 57,000 from Sweden and Norway, and 1,880,000 tons from Austria-Hungary. The latter empire was supposed to be a country where the forests had been properly managed, but this was by no means the case. It appeared from the report of the head of the Hungarian Forest Department, that after a detailed examination of the stock of timber on 22,000,000 acres, there was a total deficiency of 37 per cent., and of coniferous woods 28 per cent. If you wanted a certain annual produce of timber from a forest you must keep up the stock to a proportionate extent, and in these Hungarian forests there was a deficiency of 37 per cent., showing that they had cut not only what they had grown, year by year, but that they had trenched on the capital, which would eventually run short. The Hungarian Government had decided in future to work the forests more carefully, and with this failure of supply from Austria-Hungary, Germany would have to look to the Baltic, which would again interfere with the supply to Great Britain, which now drew 5,000,000 tons from Baltic ports. They also exported to Denmark, Holland, Belgium, France, Italy, Asia Minor, Greece, Egypt, Algeria, Cape of Good Hope, Australia, and even to India and South America, the total exports being over 10,000,000 tons. He was quite certain there would be a diminution in the supply before many years. It was said prices were low, and no donbt they fell from 1870 to 1888-89; then there was a standstill, and since then a very slow but steady rise, and when that once set in there was a probability that it would gradually increase in an almost geometrical progression. It was necessary, therefore, to consider how to make up for the coming deficiency in supply. It must be said that every day steel and iron were being substituted for wood, but the fact remained that whilst the population had increased 20 per cent. in the last 25 years, the consumption of wood had increased 45 per cent. The deficiency could be made good in two ways; either by introducing, without delay, proper forest management in Canada, or by increasing the area of forest in this country. He would not enlarge on the first pornt—Canada could supply the whole world with coniferous timber if her forests were properly looked after, for there were 1,250,000 square miles of forest land still there; but he had seen a statement made in the Ontario Parliament that for every tree brought out of the forest more than ten were destroyed in forest fires. Mr. Hutchins said that 9,000,000 acres required to be planted in this country to make up for the timber now imported; he should put it at about 6,000,000. He thought this was rather an unfortunate time, with a war on hand, to bring forward the proposal, and even if the country were at peace, he did not think anyone there would live to see Parliament vote £1,000,000 per annum for the establishment of State forests. Nor did he think it was absolutely necessary that they should be all State forests. He thought the first thing to be done was to convince private owners that it would pay to grow timber; they would soon begin to do it. Two gentlemen, Mr. Stafford Howard and Mr. Bayliss, the deputy surveyor of the Forest of Dean, had recognised the necessity and desirability that the British Crown forests should be so managed as to serve as examples of good forestry. They had obtained the services of a distinguished Indian forest officer, Mr. Hill, who prepared working plans which had been carried out during the last two years. Mr. Munro Ferguson, M.P., also had set aside 800 acres near Edinburgh for the growing of mine props, and had special working plans made for it, and also for another estate further north. He (Dr. Schlich) had been consulted by one of the largest proprietors in England, and prepared a scheme which was now being carried out for working 6,000 acres. The importance of good example could not be exaggerated; once the feasibility of the thing was shown the 9,000,000 acres would soon be found, but he doubted if the British Parliament would vote £1,000,000 annually to purchase and plant them; nor was he sure that the proprietors would be willing to sell. Still, the State might do a great deal. It could give assistance in the equipment of forest schools; it might make advances at 2½ per cent. to landed proprietors who had the land but not the means to plant it; and in certain cases it might even buy land itself, for instance in the congested districts of Ireland and in parts of Scotland. In Ireland there were 3,000,000 acres unused, and the Irish Land Commissioners often had surplus lands on their hands, which might well be put under forest; and this would help to settle in a peaceful way the Irish land question. Work could be done in winter by men who only farmed a few acres, and who could in this way earn a little money. In some parts of England and Wales the same thing might be done. Within a radius of 50 miles from London there were 700,000 acres of land unaccounted for; what a benefit it would be to the metropolis if these lands could be acquired and planted.

Dr. J. Nisbet said he was glad to hear what Sir Joseph Fayrer had said about the good results of forestry in India. In the dry, central zone of Burmah, where the scarcity of the rainfall sometimes caused famine, more or less chronic, the restoration of forests would help in future to remove those calamities. In some provinces in Burma the forests yielded a handsome revenue. In 1898, the total revenue from them gave a net surplus of over £300,000. For some years he had held the view put forward by Dr. Schlich that within a comparatively short space of time there would be a timber famine. For years past the United States had been consuming more than twice the annual growth of their forest lands. Within the British empire were the most

valuable and extensive forests in the world, and although the paucity of forests in the British Isles was so great, so long as we had supremacy of the sea we had the means of supplying our own demands. That was an economic factor which must be reckoned with. Mr. Hutchins had done a great public service in drawing attention to national forestry, but he must say he considered his scheme utopian. The Government had refused to give a million pence per annum for the spread of education in forestry, and they were not likely to spend £1,000,000 on forests. Under the present Commissioner of Woods, Mr. Stafford Howard, something had been done to improve the Forest of Dean and other forests under Mr. Bayliss. In Germany, one-fourth of the total area was forest, and Mr. Hutchins said that was the right proportion; but that depended on various circumstances. The clearance of the British forests until there was only 4 per cent. would have been ruin to agriculture but for the naturally humid climate; but if there were 10,000 square miles of forest, it was quite possible that the climate of some parts might be made so excessively humid that agriculture would suffer in that way. Even on the continent, a rainfall of 40 inches was not beneficial, and the years of excessive wet were more numerous than those of drought. The universal military service must have as much to do with the physique of the population as 25 per cent. of forest land. He also thought Mr. Hutchins had been too severe on private owners; he considered the private owner was of much more importance in this connection than the Government or Corporations. Even if the grant of a million were made to-morrow, we had not the means for planting anything like 6,000 acres a year. It would be more useful in the first place to devote the money to the proper training of forest officers, who could assist private owners, or go to Canada to help in forest administration there. Private landowners laboured under great disadvantages; land under forest was rated the same as agricultural land—in Scotland the same as pasture — and the rates had to be paid annually, though the forest might not reach maturity for over 100 years. Again the rights of proprietors in their estates varied. In Scotland a life renter could not touch timber, but a heir in tail could cut down everything, and a spendthrift son might exhaust in one year all the timber planted by his grandfather or great grandfather. There was also the iniquitous system of preferential railway rates, under which foreign produce was taken across the country at less cost than home-grown timber was taken a comparatively short distance. He hoped public opinion would impress on the Government the necessity of at least providing more facilities for instruction in forestry.

Professor FISHER said he did not see why a country, which had a revenue of £100,000,000, could not afford £1,000,000 for stocking its waste lands. As a matter of fact, between 1815 and 1825, when the country was in a very embarrassed state, after the Peninsular War, thousands of acres were planted with oak, pine, and larch. It was quite true that a good deal had been done, especially by Mr. Stafford Howard, to introduce a decent system of management in the State forests, but the management of the New Forest was exactly everything it should not be. No country in Europe could grow finer oak than England, and there was such a demand for it, that if ever there was a sale, a corner was formed to buy all in the market. The quantity produced was absolutely insufficient, and the State should certainly have one decent oak forest to show. Mr. Nisbet referred to the possibility of an excessive rainfall being produced, and the same question was raised when he gave a lecture in Dublin in March. As a matter of fact, trees might produce humidity, but there was no proof at all that they had actually increased rainfall. One thing they certainly did, and that was, to drain the soil and prevent the formation of swamps. The Irish bogs were produced by the destruction of ancient forest, and if you dug to the bottom of them you found the timber. Those forests had been cut down and sent to Spain and Portugal, to make casks for the port wine which our ancestors drank.

The CHAIRMAN, in proposing a vote of thanks to Mr. Hutchins, for his paper, and to Professor Fisher for reading it, thanked Sir Joseph Fayrer for what he had said about General Michael, whose services to India he had himself acknowledged in the discussion on a paper read here by General Michael, and published in our *Journal* of December 21, 1894. The only part of Mr. Hutchins' paper he would venture to criticise was that which spoke of the deterioration of the race, especially amongst the urban population. One must not rely too much on individual observation, but certainly, looking back 60 years and more to the people he used to see in Devonshire and Cornwall, and comparing them with those he saw there now, nothing struck him so much as the improvement of the race, particularly among the agricultural classes. They were better grown, and in every way better developed men. He attributed that chiefly to the blessings of free trade, leading to cheaper food, and to the great development of athletics and sports of all kinds. There was no doubt that the girls of the present generation were much finer than those of the preceding generation, particularly those of the urban population. The armour of old days would not fit the men of the present day; it was a size too small. With regard to the general thesis of the paper he was of opinion that there would be no difficulty in getting State aid if once public opinion were convinced of the necessity for it. In conclusion, he might refer to the active part which the Society of Arts had always taken on this and similar questions. Many of the woods throughout the country owe their present existence to the initiative of the Society of Arts. In consequence of the Society's action at the end of the last century, about three-quarters of a

million trees were planted, and between 1775 and 1781 twenty-two gold medals and other prizes were presented to landed proprietors in various parts of the country. A century before that Evelyn had interested himself in the matter, but neither his efforts nor those of the Society were followed up with sufficient energy and intelligence to avail anything for the permanent benefit of the country.

The vote of thanks was passed unanimously, and the meeting adjourned.

Miscellaneous.

FOOD SUPPLY OF THE UNITED KINGDOM.

Mr. R. F. Crawford remarked, in a paper read before the Royal Statistical Society on the 21st inst., that the total annual supply of wheat for our home population has amounted on the averages of recent years to 354 lbs. (or 5·9 bushels), of which 78 lbs. is home-grown, and 276 lbs. imported. In the case of meat the consumption approaches 130 lbs. a head, of which nearly 80 lbs. is home-grown. In the case of potatoes the supply amounts to 280 lbs. a head. Here it is remarkable that of the 5 million tons consumed, but 4 per cent. of the total is foreign-grown. The author estimates that the annual consumption of milk and of milk products in this country is equivalent to 60 gallons of milk per head, and that 36 gallons of this is produced at home. We grow ourselves nearly 80 per cent. of our oats, 60 per cent. of our barley, and 50 per cent. of our beans and peas. But it is not to be forgotten that much of our home-produced meat and milk is dependent on foreign-grown food, and much of our home-grown crops are fed on imported fertilisers. After careful examination of the various factors which must influence his estimate, Mr. Crawford concludes that we import 90 million hundredweights of feeding stuffs for the production of our meat and milk, and this imported foodstuff would, on the basis of the average yield of the country, require an area of 6 millions of acres for its cultivation. Another 6 millions of acres would be required to supply the wheat of which our home production is short. Similarly he concludes that about 11 millions of acres of homelands would be needed to produce the beef, mutton, and milk and milk products which we import. The total of these three estimates brings us to 23 millions of acres. This he compares with the actual figures of the country—77¾ millions of acres of land and water in the United Kingdom, of which but 47¾ millions are under cultivation. He then proceeded to compare the figures of the various countries under discussion with regard to their cultivated area and their density of population. Belgium, which is nearest to us in general conditions such as density of population and comparative freedom from import duties, has unfortunately few and unreliable statistics. As to meat, the consumption seems to be but 70 lbs. a head, of which 16 per cent. is imported. She imports, however, 71 per cent. of her wheat. Germany, whose population is so fast increasing, and taking at the same time to trade instead of agriculture, still (thanks perhaps to her heavy import duties) produces the greater part of the food her people use. She only imports one-third of the wheat consumed. It is noticed, too, that the average yield of the principal cereals in Germany is 20 to 25 per cent. behind that of this country. France is still further behind. She grows seven-eighths of the corn available, and imports but 3½ lbs. of meat per head of her population, out of a meat consumption of 80 lbs. a head. In his general observations Mr. Crawford pointed out that the Briton eats more meat and less bread and potatoes than his neighbours. The Belgian is sparing in meat, and the Frenchman in milk. Home production of all grains sustains 91 per cent. of the French population, 80 per cent. of the German, 46 per cent. of the Belgian, and but 39 per cent. of our own, so far as their consumption, directly or indirectly, is concerned.

CHILEAN AGRICULTURE.

About three-fourths of the persons engaged in agriculture in Chile use machinery and ploughs of European or American manufacture, the remainder using the same style of implements that were in vogue in Egypt 2,000 years ago. A pointed stick of hard wood with a single shaft stuck in the centre serves as a plough. For harrowing, a heavy beam of hard wood, with the additional weight of the ploughman standing on it, is dragged by a yoke of oxen over the rough-ploughed farms. The reaping, according to the United States Consul at Valparaiso, is done by hand; the threshing, by forming a deep circle in the open air with straw, similar to the ring of a circus, driving in from 30 to 50 mares, posting as many men at regular intervals on the outer part of the circle, and, by means of shouting, shrieking, and lashing, driving the animals fast and furiously round and round the circle, thus treading out the wheat from the ears. This is called *la trilla*, primitive, indeed, but highly satisfactory to the simple farmers who do it, as they make this the occasion for a general feast on the farm, winding up the business of the day with copious libations of *chicha* (sweet grape cider). On each farm live a number of *inquilinos*, or farm labourers, who are allowed a house to live in, a small piece of ground sufficient to cultivate enough maize, pumpkins, potatoes, and onions for the use of their families, and where they can keep a few hogs and fowls, grow grapes, oranges, peaches, quinces, &c. Peaches grow almost wild, as do quinces. The valley of Aconcagua is celebrated or its fine quality of walnuts, honey, wax, potatoes, onions, &c. About 3,000 tons of walnuts are

gathered yearly in Chile, 2,000 tons of honey, and 300 tons of wax. The *papa colorado*, or red potato, is grown in quantities, not only sufficient to supply all the midland and northern provinces, but to be largely exported to Peru and Ecuador, and sometimes to Panama and intermediate ports. The hay grown in the valley is sufficient to supply all the northern provinces and nitrate regions, and to export many thousands of bales to Peru and the Brazils. Ship loads have also been sent to England. The same broad valley from Las Vegas to Los Andes is planted for many leagues, as far as the eye can reach, north and south, with the vines of the black grape, from which is made *chicha* (cider) by boiling, sieving, and fermenting grapes together with the skins. It is estimated that 1,000,000 gallons of good sound wholesome claret could be made yearly from the grape crop of this valley. Don Guillermo Brown is the proprietor of a large vineyard, and produces great quantities of first-class claret. It is called "Vino escorial de Panquehue," the latter being the name of a village in the vicinity of the estate, near which is also the large estate of Errazuriz, producing excellent wines similar to those of the Brown estate. Grape culture extends also from Huasco to Cauquenes, or about 550 miles north and south. Delicious sweet muscatel wines are made in or near Huasco (north), and semi-sweet wines are made in Tome and Cauquenes (south). There seems to be no limit to the producing capacity of the soil, which is greatly favoured by the facilities offered for irrigation by the numerous streams of melted snow which can be, and are, trained in any required direction as they rush towards the Pacific Ocean, fertilising the lands through which they pass in a constant stream. This, of course, is applicable only to the central and southern provinces. The northern portion of Atacama, and all of Autofagasta and Tarapaca are rainless regions.

STEEL ROADWAYS IN SPAIN.

The road between Valencia and Gras is two miles in length, and an average of 3,200 vehicles pass over it daily. Until 1892 it was constructed of flint stone. The annual cost of keeping it in repair was about 35,000 pesetas (£1,400). The cost of a steel roadway was determined on, and the annual cost of keeping in repair the central zone of road thus relieved from heavy traffic—which proceeds over the steel rails—is now only 2,500 pesetas, or about £100. A Belgian firm received the contract to furnish the steel work, having sent in a lower tender than Spanish firms at Barcelona and Bilbao. According to Consul Washington of Valencia, the length of road so built is 3·2 kilometres (1·98 miles). The cost per kilometre (·621 of a mile) was 44,100 pesetas (£1,764). The total cost of the road laid was £2,438 as follows:—Steel construction, £1,764; transportation and laying steel construction, £130; and binding-stone construction between rails and lateral zones, £544. The rails during the seven years they have been in position, have not required repairing. Ample room is allowed between the rails for two horses to walk abreast. Horses do not appear to slip on rails of this construction. At each side of the rail are layers of binding stones, the paved road being higher than the fence of the rails. The municipality of Valencia is of opinion that the saving in cost of repairs, through a road of this description pays for its construction in a short time, and other and similar roadways are in contemplation. From various parts of Spain inquiries have been made concerning this road. It is stated that a similar construction was decided upon at Alicante in 1898, but was temporarily abandoned. A small toll is charged for each vehicle passing over this roadway.

Notes on Books.

THE YORKSHIRE COLLEGE, LEEDS. Textile Industries, Dyeing, and Art Departments. Leeds, 1899.

This college was founded in 1874, under the title of Yorkshire College of Science, but in 1876, in consequence of additions to the curriculum, the name was changed to the Yorkshire College. The Clothworkers' Departments of the Yorkshire College consist of textile industries, dyeing, and art, with the following branches:—*Textile Industries*: carding, combing, spinning, designing, weaving, and cloth finishing; *Dyeing*: theoretical research, and practical; *Art*: textile, general, and applied. The buildings for these departments were erected at a cost of about £60,000, and occupy about one and a half acres of land. The annual contribution of the Clothworkers' Company for the maintenance of the Textile Industries Department is now £2,500.

Referring to the influence of the textile teaching of the college on the weaving industries of the county, it is said that "the trade of Leeds in woven manufactures has been almost entirely changed since the inauguration of the classes in 1875. Up to that date it was chiefly the centre for plain-cloth weaving, whereas now fancy worsteds and woollens, dress and mantle cloths, as well as heavier makes of fabrics, are produced in the factories of Leeds and district." This illustrated handbook contains a full account of the work carried out in the Clothworkers' Departments of the Yorkshire College.

CATALOGUE OF PLATINOTYPE REPRODUCTIONS OF PICTURES, &c., photographed and sold by Mr. Frederick Hollyer. London, 1900.

This catalogue contains lists of series of works by Sir Edward Burne Jones, by G. F. Watts, R.A., and by Dante Gabriel Rossetti, which have been photographed. There are also lists of a large number of portraits of eminent men. Mr. Horace Towns-

end has contributed an introduction and notes on the different classes of reproductions here catalogued, and pages of small illustrations are added as an help to the verification of the different platinotypes.

General Notes.

COACHBUILDING.—The Company of Coach Makers and Coach-Harness Makers of London offer the following prizes for competition among British subjects engaged in the trades of coach making and coach-harness making, and members of drawing and technical classes in connection with such trades resident in the United Kingdom of Great Britain or Ireland:—Competition No. 1—Open to apprentices and others, under 21 years of age, for working drawings of a double-brougham body; 1st prize, the Company's bronze medal and £3; 2nd, £2. No. 2—Open to members of drawing and technical classes of Great Britain or Ireland. Each competitor to send three drawings of the side elevation of—(1) a double-brougham, (2) a governess car, and (3) a T cart; 1st prize, £3 3s.; 2nd, £2 2s.; 3rd, £1 1s. No. 3—Open to competitors, under the age of 25 years, for perspective designs of a four-wheel driving phaeton for a lady's use; 1st prize, £3 3s.; 2nd, £2 2s.; 3rd, £1 1s. No. 4—For drawings in perspective of a pair-horse, angular landau; 1st prize, the Company's silver medal and £5; 2nd, the Company's bronze medal and £4; 3rd, £3; 4th, £2. No. 5—Mr. Robert Downs (master of the Company) offers £10 10s., to be divided as follows, for essays on a pair-horse carriage harness, describing the materials used, and illustrated by sketches; 1st prize, £5 5s.; 2nd, £3 3s.; 3rd, £2 2s. The above prizes will be accompanied by the certificate of the Company. The prize winner in any of the competitions, if not already free of the Company, may have the Honorary Freedom conferred upon him, should his drawing or essay in the opinion of the judges deserve it. Drawings and essays to be delivered free at the hall of Company, Noble-street, St. Martin's-le-Grand, London, on or before the 31st day of March, 1900.

WATER-POWER IN INDIA.—The conversion of waterfalls into sources of power, since the historic success achieved at Niagara, has proceeded with an accumulated vigour, and promises before long to introduce a new feature into industrial economy. *Feilden's Magazine* is informed that three extensive schemes of this kind are being considered in India, viz., the utilisation of a fall in Cashmere, that of the great Silva Tamundrum Falls on the Cauvery, and the Nerbudda Falls near Jubbulpore. The power, of course, will be exerted by turbines to operate electric generators, the resulting electric current being used for the electric furnace and to drive motors. Up to the present, electricity generated by natural water-power has been chiefly utilised for several special industries, notably the production of what are called electro-chemical products—especially aluminium and carbide of calcium. There is no reason to suppose, however, that in such a country as India, with its teeming native population, water-power could not take the place of coal to a material degree for industrial uses apart from those for which it has been hitherto chiefly employed.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

The meetings of this Section will take place on the following Wednesday evenings at 8 o'clock:—

NOVEMBER 29.—"The Great Seals of England." By ALLAN WYON, F.S.A., Chief Engraver of Her Majesty's Seals. RICHARD R. HOLMES, M.V.O., F.S.A., Librarian to the Queen, will preside.

DECEMBER 6.—"Artificial Silk." By JOSEPH CASH. SIR THOMAS WARDLE will preside.

DECEMBER 13.—"Sea Angling and Legislation." By F. G. AFLALO. J. W. WILLIS BUND will preside.

DECEMBER 20.—"Bi-Manual Training by Blackboard Drawing." By H. BLOOMFIELD BARE, F.R.I.B.A. WALTER CRANE will preside.

Papers for meetings after Christmas:—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E.

"The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Electrical Induction Motor on Mountain Railways." By PROFESSOR CHARLES A. CARUS-WILSON, M.A.

"Ventilation without Draughts." By ARTHUR RIGG.

"The Undeveloped Resources of the Bolivian Andes." By SIR MARTIN CONWAY.

"The Orloff Process of Colour Printing." By W. H. WARD.

"Continuation School Work in Rural Districts." By H. MACAN.

"Artistic Copyright." By EDWIN BALE.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons at 4.30.

December 14, January 18, February 8, March 8, April 26, May 17.

DECEMBER 14.—"Round about the Andamans and Nicobars." By COLONEL R. C. TEMPLE, C.I.E. The Right Hon. HENRY H. FOWLER, G.C.S.I., M.P., will preside.

"Our Work in India in the 19th Century." By SIR WILLIAM LEE-WARNER, K.C.S.I., M.A.

"The Industrial Development of India." By J. A. BAINES, C.S.I.

"New Projects of Railway Communication with India." By J. M. MACLEAN, M.P.

"Indian and English Criminal Procedure." By SIR JOHN SCOTT, K.C.M.G., D.C.L.

FOREIGN AND COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons, at 4.30 and the first meeting on Thursday:—

February 1, 27, March 20.

FEBRUARY 1.—"The Century in our Colonies." By The Right Hon. SIR CHARLES DILKE, Bart., M.P.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday evenings at 8 o'clock:—

January 30, February 13, March 13, April 3, May 8, 29.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday evenings at 8 o'clock:—

HENRY HARDINGE CUNYNGHAME, "Art Enamelling upon Metals." Four Lectures.

LECTURE II.—NOVEMBER 27.

Method of executing Limoges enamels—Preparation of the metal plate, of the enamels—The firing paillons.

LECTURE III.—DECEMBER 4.

The method of making enamels—Fluxes—The metallic oxides.

LECTURE IV.—DECEMBER 11.

The application of enamel to jewellery—Gold working—Gilding.

BENNETT H. BROUGH, "Metalliferous Deposits." Four Lectures.

January 22, 29, February, 5, 12.

E. SANGER SHEPHERD, "Photography of Colour." Four Lectures.

March 5, 12, 19, 26.

MAJOR PHILIP CARDEW, R.E., "The Control, Regulation, and Measurement of the Supply of Electrical Energy." Three Lectures.

May 7, 14, 21.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor lectures.) Mr. Henry Hardinge Cunynghame, "Enamelling upon Metals." (Lecture II.)

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. P. E. Pilditch, "Party Walls under the London Building Act, 1894."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Vaughan Cornish, "Desert Sand Dunes."

Actuaries, Staples-inn Hall, Holborn, 5½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. B. Bottomley, "Vegetable Appetites and How Satisfied."

TUESDAY, Nov. 28...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on papers:—Mr. H. H. Dalrymple-Hay, "The Waterloo and City Railway;" Mr. Bernard M. Jenkin, "The Electrical Equipment of the Waterloo and City Railway." 2. Mr. C. Newton Russell, "Combined Refuse-Destructors and Power-Plants."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. Sanger Shepherd, "Practical Three-Colour Slide-making."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. L. A. Borradaile, "The Hatching-stage of the Land Pagurines." 2. Mr. J. S. Budgett, "General Account of an Expedition to the Gambia Colony and Protectorate in 1898-99." 3. Dr. W. G. Ridewood, "The Relations of the Efferent Branchial Blood-vessels to the 'Circulous cephalicus' in Teleostean Fishes." 4. Mr. G. A. Boulenger, "The Reptiles, Bactrachians, and Fishes collected by the late Mr. John Whitehead in the interior of Hainan."

WEDNESDAY, Nov. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Allan Wyon, "The Great Seals of England."

United Service Institution, Whitehall, S.W., 3½ p.m.

British Astronomical, Sion College, Victoria-embankment, W.C., 5 p.m.

THURSDAY, Nov. 30.. Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. A. W. Clayden, "Thunderstorms."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. B. Worsfold, "England in South Africa" (Lecture IV.).

Camera Club, Charing-cross-road, W.C., 8½ p.m. Mr. Basil Williams, "Travel in Persia."

FRIDAY, DEC. 1..Geologists' Association, University College, W.C., 8 p.m. 1. Dr. A. W. Rowe, "The Zones of the White Chalk of the English Coast.—I. Kent and Sussex." 2. Mr. W. H. Wickes, "A New Rhætic Section at Bristol."

Junior Engineers, Westminster Palace-hotel, S.W., 8 p.m. Mr. G. Drysdale Sweetman, "Natural Methods for the Purification of Water-Carried Sewage."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Journal of the Society of Arts,

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FRIDAY, DECEMBER 1, 1899.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, 1900, at 7 o'clock, by HERBERT JACKSON, on "The Phenomena of Phosphorescence."

Due notice will be given when the tickets for the lectures are ready for issue.

A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received. Subject to these conditions each member is entitled to a ticket admitting two children and an adult.

FOREIGN & COLONIAL SECTION.

Thursday, November 23, 1899; SIR THOMAS SUTHERLAND, G.C.M.G., LL.D., M.P., in the chair. The paper read was "Old and New Colombo," by JOHN FERGUSON.

The report of the paper and discussion will be printed in a future number of the *Journal.*

CANTOR LECTURES.

Mr. HENRY HARDINGE CUNYNGHAME delivered the second lecture of his course on "Art Enamelling upon Metals," on Monday evening, 27th November.

The lectures will be printed in the *Journal* during the Christmas recess.

Proceedings of the Society.

THIRD ORDINARY MEETING.

Wednesday, November 29, 1899; RICHARD R. HOLMES, M.V.O., F.S.A., Librarian to Her Majesty the Queen, in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, W. E., 27, Chancery-lane, W.C.
Cockell, Norman Alexander Lindsey, Glenisla, 18, Dorville-road, Lee, S.E.
Forester, Thomas, Phœnix Works, Longton, Staffs.
Hall, Thomas, 8, George-street, Edinburgh, and 25, Great Portland-street, W.
Longsdon, Henry Crofts, Phœnix Foundry, Keighley, Yorks.
Paten, Alfred John, City and Counties Club, Peterborough.
Pearce, Walter John, 68, Lansdowne-road, Didsbury.
Sandover, William, Ashburton, Richmond, Surrey.
Smith-Delacour, Ernest Walter, LL.D., Paramaribo, Surinam, Dutch Guiana.
Torrey, Edward Strong, 15, Britannia-street, King's-cross, W.C.
Wall, A. B., Oak Bank, Cheltenham.

The following candidates were ballotted for and duly elected members of the Society:—

Bubb, Henry, J.P., Ullenwood, near Cheltenham.
Bush, Montague, 23, Marlborough-place, St. John's-wood, N.W.
Carnelley, William, Fallowfield, Manchester.
Carr, Cuthbert Ellison, 1, Collingwood-street, Newcastle-on-Tyne.
Channon, Henry James, 20, Lewisham-hill, Lewisham, S.E.
Christy, Frank, 47, Broomfield-road, Chelmsford.
Church, Col. George Earl, 216, Cromwell-road, S.W.
Clarke, Lieut. Maurice Harvey, R.N.R., Coleswood, Harpenden, Herts.
Cooper, Rev. William Hargreaves, 9, Wellesley-road, Sheffield.
Cronin, Alfred Charles, 25, Kensington-palace-mansions, W.
Danson, Francis Chatillon, 74, Bidston-road, Birkenhead.
Davey, William John, 6, Water-street, Liverpool.
Driver, Charles William, 153, Sutherland-avenue, W.
Elliott, Walter John, M.A., 62, Springfield-place, Leeds.
Farnworth, Ernest, Rosslyn, Goldthorn-hill, Wolverhampton.
Ferguson, Charles J., J.P., Cardno-lodge, Carlisle, and 41, Elm-park-gardens, South Kensington, S.W.
Fogg, Charles Albert, 39, Park-road, Bolton, Lancashire.
Gamble, James Sykes, C.I.E., M.A., F.R.S., Highfield, East Liss, Hants.
Gray, Charles Joseph, Pietermaritzburg, Natal.
Gray, James, 5, Allan-street, Dalmarnock, Glasgow.
Hales, Charles, 4, Copthall-chambers, E.C.
Harris, Dr. F. Rutherford, Llangibby Castle, Usk.
Harvey, Surgeon-General Robert, M.D., C.B., D.S.O., The Yarrows, Simla, India.
Hunter, W. Henry, Oakhurst, Eccles Old-road, Manchester.
Hurst, Walter, 17, Doughty-street, W.C., and Tadcaster, Yorks.

Innes-Baillie, Charles J., Ballygunge, Grove-hill-road, Denmark-hill, S.E.
Klein, Walter G., 24, Belsize-park, N.W.
Lee, Arthur, J.P., 10, Berkeley-square, Clifton, Bristol.
Lyon, N. J., Guards' Club, S.W.
Morrow, Captain John, M.Sc., University College, Bristol.
Nuttall, Harry, Raynor-croft, Bowdon, Cheshire, and 2, Albert-street, Manchester.
Phillips, John, 81, Wood-lane, Treeton, Rotherham.
Ramsay, Alexander, 4, Cowper-road, Acton, W.
Romanes, John, 3, Oswald-road, Edinburgh.
Saunders, William Henry Radcliffe, 29, Bramham-gardens, South Kensington, S.W.
Strachan, Henry, L.R.C.P., M.R.C.S., Lagos, West Africa.
Stuart-Menteth, W. F., Municipal Office, Darjeeling, Bengal, India.
Tahourdin, Horace Foster, 63, Queensborough-terrace, Hyde-park, W.
Temple, Charles Lindsay, Vice-Consulate, Manaos, Amazonas, Brazil.
Tower, Christopher, The Weald, Brentwood, Essex.
Vincent, William Hugh, Corporation Electricity Works, Wellington-road, Ashton-under-Lyne.
Ward, Charles Blyth, Shirley, Sheffield.
Waterhouse, Mrs., Denehurst, Oxford-road, Moseley, Birmingham.
Webber, Wallace James, 6, The Avenue, Keynsham, near Bristol.
Younghusband, Major George I., Murree, Punjab, India.
Yoxall, James Henry, M.P., 7, Pagoda-avenue, Richmond, Surrey.

The paper read was—

THE GREAT SEALS OF ENGLAND.

By Allan Wyon, F.S.A.,
Chief Engraver of Her Majesty's Seals.

There is, I suppose, no barrister who has not at least within a week of his being called to the bar had a dream, either during his sleeping or waking hours, of taking his seat on the woolsack, and holding the office of Lord High Chancellor. Should there be amongst the audience whom I have now the honour of addressing one who may be called to that distinguished post, he will find that before taking his seat upon the woolsack he will have to pass through a ceremony of great importance. Called into the presence of his sovereign, he will (unless old precedents are no more followed) find there, lying on a table, a box to which Her Majesty will point, and by this wave of the hand intimate to him that he is to take charge of the box and its contents. After kissing the hand of his sovereign, the honoured lawyer will retire from the royal presence, bearing away with him in the box the Great Seal of England: the possession of which, under such circumstances, will have constituted him Lord High Chancellor of England, with all the responsibilities, dignities, and emoluments appertaining to the office.

Let us for one minute, in imagination, follow the newly appointed Lord Chancellor into the seclusion of his own house, and there, with him, open the box and look at its contents. He will find there a large mass of sterling silver, weighing about 185 ozs.: measuring about 6½ inches diameter by 1¼ inch in depth or thickness. He will find that this mass of silver is in two parts, each smooth on the outside, each engraved with an elaborate design within. In use these two surfaces engraved with these designs are impressed upon a lump of wax, attached in an ingenious way to any document to which the sovereign, in Her Majesty's character as sovereign, gives her royal assent. Such deeds, called letters patent, charters, &c., acquire all their legal force and power from the Great Seal being thus attached to them. The mode of attachment you will observe from the letters patent which I now exhibit to you. You will see that the wax seal is attached by cords so woven through holes, specially made in the parchment, that either the parchment cord or wax must be mutilated to separate them. To provide room for the cords to pass through the silver seal the metal is cut away slightly at the top and bottom of each of the two silver sides. To ensure the impression being correctly made upon the wax two guides on the lower seal are made to fit in corresponding slots in the upper seal.

Whilst showing you this seal I wish to guard myself against two perils. The first is a peril to which I may be exposed from law-keepers. It is an act of treason felony to counterfeit the Great Seal. I, therefore, wish distinctly to assert that, although this which I am showing you is a reasonable resemblance of the Great Seal—made to convey an exact idea of what the Great Seal is like—I have made such differences in it, that it is no more exactly like the Great Seal than the imitation sovereigns and spade guineas which you can buy almost anywhere as card counters are exactly like the present or former current coins of the realm. Secondly, I want to guard myself against a peril to which I may be exposed from law breakers from having in my possession this

large article of shining metal. I therefore assert that this is not a mass of silver, but of cheap metal, plated; so that should I be attacked and this taken from me the metal would be found to be of so slight a value that the law breaker, in this instance, at least, would find that his game would not be worth the candle.

Insignificant, however, as the value of this dummy is, the value of the genuine seal is by no means so. Its value, after melting, would be £25 to £30. To this must be added the cost of engraving, by which is produced an instrument for carrying on the work of the Government in the country of such a nature that, were it lost, or access obtained to it by fraudulent persons and by them applied to improper documents, the mischief, confusion and delay in the public business of the country would be very great indeed. Hence all Lord Chancellors have taken the greatest care of the seal. Recesses have been made in walls and strong steel safes with elaborate locks have been made for its custody. One Lord Chancellor, Heneage Finch, Earl of Nottingham, in Charles II.'s time, had such a loving care for the seal that he used to take it to bed with him and lay it under his pillow. It was well that he did so, as at one o'clock on the morning of the 7th February, 1677, thieves broke into the Chancellor's house and stole the mace of the House of Lords and the ornamental bag made for the Great Seal. The seal itself, however, escaped capture, as it was lying under his Lordship's head safely in bed.

The study of the designs or devices upon these seals have for many years (certainly ever since James I.'s reign) been a subject of much interest to all those who have felt any concern in the history of this country. An accurate acquaintance with them is absolutely necessary in some legal enquiries and in verifying historical documents; but a slighter knowledge of them will be found very interesting, as they afford an admirable reflection of the fine arts in England from the time of King Edward the Confessor to that of Queen Victoria. The seals, it must be remembered, were all engraved during the reigns of the sovereigns whose names they bear, and are to be regarded as positive witnesses in many points to historical facts or customs. We shall find this to be the case, whether we look at the legends, the heraldic charges, or in many cases at the costumes worn by the sovereigns. The circumscriptions or legends on the seals, appearing, as they generally do, upon both sides, state the royal style and title, and these alone, varying as they do from time to time, will be found in themselves to present an epitome of English history. Again the royal armorial bearings which have appeared upon the Great Seals for 700 years, and the changes in them from time to time furnish heraldic illustrations of and commentary on the progress of the history of this country. Further, the regal costume, together with the weapons and armour worn by the sovereigns from the time of William the Conqueror, and for many subsequent generations, furnish the students of armour and costume with abundant material of exact and contemporaneous illustration of what was worn by the sovereign from time to time throughout the many years of English history.

I now propose to look a little more closely at the character of the designs on the seals.

As I have said the seals have two sides, and this has been the practice ever since Edward the Confessor's day. One side of the seal has usually been employed to set forth the sovereign enthroned as the sole supreme dispenser of justice and authority within the realm. On the other side, the sovereign has usually been made to appear on horseback (nearly always armed) as the head of the military forces of the kingdom, and as the representative of England to the outer world.

In illustration of these remarks I now invite your attention to some lantern views of the seals.

VICTORIA.—(Third Seal).

We have here one side of the Great Seal of England, which is at present in use. You see the Queen enthroned, crowned—in her coronation robes—and wearing the collar and badge of the Garter, holding in her right hand a sceptre terminating in a cross, and in her left hand an orb, ensigned with a cross, her right foot resting upon a footstool. On the Queen's right side is a seated female figure emblematic of Justice, holding a pair of scales and a sword. On the Queen's left is Religion, supporting a cross with her right arm, and with her left hand a clasped Bible, on the cover of which is a triangle (as the sacred symbol of the Blessed Trinity). In a niche on the Queen's right is a figure, draped in a long robe, holding a book; on the Queen's left is the figure of a Bishop, in episcopal robes, wearing a mitre, holding a pastoral staff in his left hand, whilst his right hand is raised in benediction—these two small figures signi-

fying that the throne is established under the sanction of the Law and the Church.

Other ideas are suggested by the seal, but these I propose, for the time, to pass unnoticed, until we reach it again at the end of the few seals which I have selected to bring under your notice this evening.

Offa.

This is the earliest impression of any seal used by a sovereign in England. It is the seal of Offa, King of Mercia, and is attached to a charter confirming a grant of land in Sussex to the Abbey of St. Denis in the year 790 (*i.e.*, a little more than 1,100 years ago). The seal is about $1\frac{1}{4}$ inch in height by $1\frac{1}{8}$ inch in width. As you see, it is the portrait of the King, in profile, the neck bare, the head slightly stooping, and the hair bound by a narrow fillet, with some small leaves of laurel or olive. The word REX is legible in front of the face, and, although now undiscernible, no doubt the word OFFA was behind the back of the head.

This sovereign did much to consolidate the heptarchy into a monarchy. He was the friend of the learned monk Alcuin, and of King Charlemagne. And as we look at this contemporary portrait of him we may remember the description given of him by his biographer, writing at the same time, who said that Offa was elegant in body, eloquent in discourse, with a penetrating eye.

Edward the Confessor.

This is the first seal in this series which was made pendant to the charters to which it was affixed, and consequently has two sides. The size of the seal was 3 inches diameter. Unlike the vast majority of all the subsequent seals, the King here on both sides is represented enthroned. As you will notice the throne is a cushioned seat without supports for either the back or the arms of the King. The King's features are tolerably well marked, and he wears thin moustaches and a pointed beard. In his right hand he holds a sceptre, ending in a trefoil, and in the left an orb.

Counter-seal.—This side of the seal is very similar to the one we have just been looking at. But the long sceptre in the King's right hand ends in a dove; whilst the orb in the King's left hand is here replaced by a sword. The inscription here is the same as on the other side SIGILLUM EADWARDIE ANGLORUM BASILEI. Two points of interest are noticeable here (1) the extreme simplicity, so characteristic of the latest days of the Anglo-Saxon monarchy; and (2) the form of the title of King or Emperor (Basileus) a Latinised Greek word, such as the Anglo-Saxons had so great a fondness for, that their writings are often unintelligible to any one unacquainted with Greek.

William the Conqueror.

There is no mistaking the military character of this sovereign as he appears here on horseback, clad in a hauberk of chain-mail over his tunic, with his head protected by a helmet, and holding in the right hand a lance, and on his left arm a shield.

Counter-seal.—Here is the Conqueror enthroned, crowned, holding in his right hand a sword, and in his left hand an orb, from which proceed a cross *pattee fitchee.*

The legend commenced on the other side of the seal is completed here—together the two sides form two hexameter lines :—

HOC NORMANNORUM WILLELMUM NOSCE PATRONUM SI
HOC ANGLIS REGEM SIGNO FATEARIS EUNDUM

It will not have escaped the notice of many of you that here William gives priority to his title of "Patron" or Protector of Normandy over that of King of England, notwithstanding the higher rank of king and the greater extent of his English dominions. It will be remembered that our gracious sovereign Victoria uses the title Queen of Great Britain and Ireland before that of Empress of India. In both cases we are reminded of the conquest of a larger country by the people of a smaller.

There is one feature in the engraving of the seal which you are now looking at which is certainly noteworthy, illustrating as it does the care and accuracy of detail which many even of the earliest seals received at the hands of their engravers. Looking at the figure of the King as seated here we can at once perceive an aldermanic habit of body which the doctors describe as an *abdomen pendulum.* That William the Conqueror had this peculiarity we know from history. For we there read of the severe inconveniences which he again and again suffered from it. On one occasion when he had promised to visit his suzerain, Philip, King of France, the Norman Duke was prevented by an attack of illness in this region or his body. Philip, on learning of the cause of William's illness, laughed and expressed a hope that the Duke of Normandy might make

a good recovery, and said that after such a lying in, the Cathedral of Notre Dame itself would hardly hold all the candles that should be lighted upon the churching of such an important personage. This jest was repeated to William, who flew into a great rage, and swore by a most frightful oath that when well enough he would enter the territories of Philip and cause there fires to be lighted that would make a greater illumination than if the whole of Notre Dame were lit with candles, and added the Duke of Normandy, King of England, "those illuminations shall not be at my expense."

Shortly afterwards when William was better he put himself at the head of his army, and invaded the territories of King Philip. One of the first towns which William seized was that of Mantes, to which his soldiers set fire, burning even the church, in which lived two anchorites who refused to leave the building. Their position was made known to William, who ordered that the fire was not to be abated for them, and so they and all the town perished in the flames. The day after, the Conqueror rode in savage delight over the blackened ruins—but as he went his horse put its foot into a mass of hot cinders, which caused it to start aside suddenly; this threw William against the pommel of his saddle, and such was the injury inflicted that the King shortly died after most agonised sufferings.

William the Conqueror.

Henry Junior.

This seal is remarkable in itself and for the history connected with the king whose authority it represents.

The seal was a trifle over 3 inches in diameter; it has not a counter-seal; its style is French. The King was the son of Henry II. and reigned with him at the same time. Never in English history has there been a like situation. From Fabyan we learn that when Henry, the eldest son of Henry II., had attained the age only of fifteen years, his father determined to have him crowned and invested with royal dignity and authority "to the end he might have full authoritie to rule thys lande and the people of the same whyle his father (Henry II.) was occupied in Normandie and other countreys, where his landes laye," and where he had as much as he could do to hold them.

As a matter of policy the act was in no way successful. The young prince was first crowned with great solemnity at Westminster, 15th July, 1170, by the Archbishop of York. This greatly aggravated the contention existing between the King and Thomas a'Becket, Archbishop of Canterbury, supported by the Pope, with whom the King was already at strife as to an invasion of the privileges of the See of Canterbury and serious contravention of a papal bull. It was also a cause of offence to the King of France, because his daughter, Margaret, who was

married to the young Prince Henry, was not crowned at the same time. To appease the King of France, the ceremony of coronation was repeated at Winchester in 1173, when the Princess Margaret was at the same time crowned Queen.

But the elevation to royal dignity seems to have filled the mind of the young prince with overweening pride and ambition. Forgetful of all filial duty he openly rebelled and waged war against his father, but died in a repentant state of mind, at the early age of 26, near Le Mans, where he was first interred. As he had been twice crowned, so he was also twice buried, the second time at Rouen.

The omission of the words "DEI GRATIA" from the legend of this king's seal, the only instance of their omission in the whole series of great seals from William II. to the present day, may be thought in harmony with the career which was so full of strife and bitterness, and which terminated so unhappily. The use of this seal is a proof of the fact that this Henry Junior actually exercised royal authority.

RICHARD I.—(Second Seal.)

The size of this seal is 3⅝ inches diameter. As you will perceive, the artistic workmanship displayed by it is improving.

There are two points of history in connection with this seal which are interesting—(1) The occasion of it being engraved—Richard had had a previous seal which had been in use for about eight years, this, however, the lion-hearted King took with him when he went on the famous crusade with which his name is for ever associated. The seal he delivered to the keeping of his Vice-Chancellor, Malchien, who accompanied the King, and who kept the seal in a bag tied round his neck. In the Mediterranean sea, near the Island of Cyprus, Malchien was drowned with the Great Seal suspended around his neck. The seal having been thus lost, a new seal was prepared, and it is an impression from this new one that yon are now looking at. (2) After the King's return to England he required all charters granted under his former seal to be confirmed under his second, "whereby," says Speed, "he drew a great masse of money to his treasurie."

This seal is further noteworthy as being the first instance in which the royal shield is charged with the three lions passant guard and in pale, which ever since have been the charges of the Royal Arms of England.

EDWARD III.—(First Seal).

This seal is one of the first that was used for more sovereigns than one, some slight alteration being made by each successive King. This seal was made for Edward I.; but then it was without the castles and fleurs-de-lis, which you now see upon it. Edward II. used the same seal, but added these two castles —the allusion being doubtless to the King's mother, Queen Eleanor, daughter of King Ferdinand III., of Castile, the arms of Castile being a castle. Edward III. added the fleurs-de-lis, alluding no doubt to the King's mother, Queen Isabella, daughter of King Philip IV. of France, the arms of France at that time being semée de lis.

EDWARD III.—(Fifth Seal).

Edward III. had in all eight Great Seals. The one that you are looking at is the most famous of all, and is known as "the Brétigny Seal." The King on previous seals had used the title of the "King of France," but having renounced that title, by the Treaty of Brétigny in May, 1360, this seal was ordered to be engraved. You will notice that although the title is omitted from the legend, the arms of France are still retained in the first and fourth quarters of the shield.

This seal is considered one of the two most beautiful of the Gothic Great Seals of England. Its design is worth looking at. You see the King enthroned, crowned, holding in his right hand a sceptre terminating in a reliquary, and in his left an orb, on which is a cross crosslet at the end of a long stem. In the central niche in the canopy of the throne is a half figure, apparently crowned, holding up the right hand in benediction. In the side niches are oak trees, in the leaves of which is a bird, and on the ground at the base is a greyhound. From the upper part of each tree is suspended a shield, charged with the arms of France and England quarterly. Two lions sejant sit beside the King, one on each side. Above the lions sejant between the throne and the side niches are two very narrow niches, each crowned with a canopy, from which springs a slender pinnacle. In the narrow niche on the King's right is a figure of the Blessed Virgin with the Holy Child; on the left is a figure of St. George. Further from the centre are men at arms.

Counter-seal.—This seal is so beautiful that I show both sides. Here I would merely call your attention to the elegant fan crest—to the

inner border enriched with a series of twenty-four cusps, the spandrils filled with tracery, the whole forming a beautiful rose. In place of a cross to mark the commencement of the legend is the hand of blessing.

This seal with altered legends continued to be one of the Great Seals of England for 111 years. In 1372 Edward III. himself had the legend altered, bringing in again the title of King of France; the omission of which from the royal title was the occasion of the engraving of this seal.

In 1377 Richard II. altered the letters EDW. to RIC., thus altering the name EDWARDUS to RICARDUS, and continued the use of the seal throughout his reign.

In 1399 Henry IV. having deposed Richard II. took this seal, and having altered RICARDUS to HENRICUS used this seal for about nine years.

In 1408 Henry had a new seal made and brought into use.

Henry IV.—(Second Seal).

The significance of this seal is full of interest. But, before pointing that out, permit me, very briefly, to remind you of the circumstances under which Henry came to the throne, and so to gather the probable desires he had in his mind when he ordered this seal to be engraved.

Henry had taken up arms against Richard II., and he had really won the Crown by force, he had also been called to the throne by election by Parliament; yet he preferred to defend his title on the ground of descent from Henry III., through Edmund, the younger, or, as he maintained, the elder son of that King. On the deposition of Richard II., Henry IV. formally stated his claim in the presence of Parliament "as being the ryght blood coming of the King Henry (the third)."

Henry IV., however, was always regarded as a usurper by a strong party in the kingdom, against whose conspiracies he had to contend to the end of his reign. These conspiracies, in which many of the great nobles and ecclesiastics took part, were, in fact, the first mutterings of that storm which, although restrained by the arts and policy of Henry IV., and during the life of his heroic son Henry V., by the commanding greatness of his character, broke out afterwards with devastating fury in the Wars of the Roses under Henry VI.

And so with the anxiety natural to an usurper to invoke all the sanctions which might give sacredness to his claim in the eyes of the people he had this seal engraved, thereby, as you will perceive, indirectly appealing at once to the popular affection for the memory of the Anglo-Saxon kings, to the reverence for the Blessed Virgin and Saints which would enlist the sympathy of the great ecclesiastical party, and to the attachment to hereditary right so characteristic of the English people, on which justly or unjustly, he chose to defend this claim to the throne.

With these prefatory remarks, let us now examine the seal before us. In all perfect impressions of the seal the head of the King is strikingly like that of the recumbent statue over his tomb in Canterbury Cathedral. In the canopy over the King's head are half-length figures, the Blessed Virgin with the Holy Child being in the centre; on her right is a king crowned holding a sceptre; on her left is a martyr holding a palm. In the tabernacle work lower down are St. Michael the Archangel and St. George, each trampling on a dragon. In lower niches are St. Edward, King and Confessor, and St. Edmund, King and Martyr. In the upper part of the adjoining space on each side is an angel holding a shield, that on the King's right is charged with the Arms of Edward the Confessor, that on the King's left with the Arms of Edmund the Martyr. Below the angels on each side is a canopied niche, in each of which is a man-at-arms holding a banner—one being the banner of France and England quarterly, the other being the banner of England alone. In the outermost vertical spaces on either side are the emblems of the four evangelists, viz., an eagle (St. John), an angel (St. Matthew), a winged lion (St. Mark), and a winged ox (St. Luke).

The base of the throne is divided into three panels, each bearing a shield representing respectively the principality of *Wales*, the dukedom of *Cornwall*, and the earldom of *Chester*. These three baronies had first been united in the person of Edward the Black Prince, but subject to conditions which limited them to the eldest son of the King of England. On the death of Edward the Black Prince, therefore, they did not devolve upon Richard II., but merged in the Crown, and although Richard II. had by a fresh creation been made Prince of Wales, Duke of Cornwall, and Earl of Chester, by Edward III., it was with the same limitations. On his deposition, therefore, these baronies again merged in the Crown; and here we may again trace the over anxiety of a usurpur to assert his claim not

only to the Crown, but to all the "appurtenances" thereof.

Let me now briefly sum up what appears to be the general scheme and idea of this seal. The King is seated in state enthroned and crowned, and holding the emblems of royalty as the fountain of justice and authority in the realm. He is attended on his right and left by the Archangel Michael and St. George, the former representing angelic might triumphant over the powers of darkness; the latter representing the military prowess of England triumphant over oppression and wrong; and in a lower rank than these, but still as mighty protectors of his throne, the two most revered of his royal predecessors, who had been immortalised by admission to the hierarchy of saints, and whose names served to remind the beholder of his claim of descent from Henry III. Beyond these figures of angelic, heroic, royal and saintly personages are displayed the armorial bearings of his realm, upheld by figures representing the stalwart strength of his knights and men at arms. Above these banners, and as it were in the celestial regions, angelic hands sustain the armorial bearings of the two royal saints below, as if to symbolise the heavenly glory which is held out as the reward of a just and saintly rule in the earthly kingdom. Beyond these, in the outer compartments, are the symbols of the four evangelists, representing the divine laws of justice and mercy, in accordance with which the kingdom is to be ruled. Above the King, who wears the crown of St. Edward, and holds the emblems of royalty, as on the day of his coronation, appears the Blessed Virgin, from whose special favour, as he pretended or believed, he received the miraculous oil with which he was then anointed; on her right and left are other two saints. And below his feet are the shields of the three most exalted baronies of the kingdom, which are declared to be irrevocably annexed to the throne, or to the eldest son of the reigning King of England.

If this be the true interpretation of the seal, then it is the most interesting of all the mediæval Great Seals, not only on account of the skill with which these various ideas are arranged and harmonised, but because it bears most strongly impressed upon it, the personal traits of the reigning sovereign, and because of its requiring for its complete explanation a compendium of the history of the time even fuller than that which I have ventured to bring before you.

Counter-seal.—This is the reverse of the seal you have just been looking at, but as I have taken up so much of your time in examining the other side I simply show this side where the design is simpler but the execution of the work is full of beauty and of power, merely adding that the seal itself was made of gold and the impressions are of about 5 inches diameter.

Henry VIII.—(Third Seal).

This is the third seal of King Henry VIII. It came into use in 1542. Until now the Gothic character of the seals had for about 300 years been maintained, but as you look at this you see that the Gothic period has departed. For better or worse, it has been left behind, and we are now face to face with a new style of art and a new order of things. The throne is distinctly of the Renaissance style, the canopy consisting of a flattened oval arch surmounted by a triangular pediment. The features of the King are very life-like. For the first time you see the Royal Arms encircled with an inscribed Garter, and ensigned with the Royal Crown. The legend claims special attention. It runs: "HENRICUS OCTAVIUS DEI GRATIA ANGLIÆ FRANCIÆ ET HIBERNIÆ REX FIDEI DEFENSOR ET IN TERRA ECCLESIÆ ANGLICANÆ ET HIBERNICÆ SUPREMUM CAPUT." Henry VIII. was the first king to place a numeral after his name upon his seal. In this seal the title of "REX HIBERNIÆ" is for the first time adopted in place of "DOMINUS HIBERNIÆ." The title of "FIDEI DEFENSOR" is new to us (although Henry had used it on his second seal), and we are forcibly reminded of the religious struggles of the Reformation, in which the King had personally become a combatant with the pen, and had received from the Pope the title of "Fidei Defensor," which appears here, and which since then has constantly remained a part of the royal style. The title "In terra ecclesiæ Anglicanæ et Hibernicæ supremum caput," was one around which so many storms of ecclesiastical and political controversy had raged, and on account of which Sir Thomas More, Cardinal Fisher, and many another had suffered death, here takes its place formally in the Royal style and title.

Counter-seal.—Time allows me only to show this, and to point out the double rose in the field of the seal and the greyhound current collared in base, the one the badge of the Tudor House and the latter one of the badges of the House of York.

Philip and Mary.

This is an entirely new design. Both King and Queen are here seen enthroned together—both lay their hands upon the gigantic orb resting on a pedestal between them. The King holds a sword in his right hand, the Queen a sceptre in her left. On the front panel of the pedestral is a small crown, and the letters P and M united by a knot. We are here reminded of the perilous conditions to which the liberties of this country were exposed by the unhappy marriage of our queen to a foreign king. Look at the Arms and see the shields of Castile, Leon, Arragon, Sicily, Grenada, Austria, Burgundy, Brabant, Flanders, and Tyrol, all taking precedence of the Arms of France and England, and think of the position to which this country would have been relegated had the union of these countries been of any long continuance.

Counter-seal.—Here are the King and Queen both on horseback pacing to the left. The field is diapered with inter-lacing ovals, in the centres of which are placed double roses, fleurs-de-lis, and pomegranates alternately.

Elizabeth.—(Second Seal).

We at once recognise good Queen Bess as on horseback; she is pacing to the left, holding sceptre and orb, and wearing a moderate-sized crown and a coif on her head, and the well-known large ruff round the neck; whilst light from Heaven streams down upon the head of Her Majesty. In the field is a double Tudor rose, a fleur-de-lis, and a harp, each ensigned with a crown. It is noteworthy that Ireland not only received more attention from the statesmen of England during Elizabeth's reign than it had for centuries before, but that for the first time the harp, the badge of Ireland, makes its appearance upon the Great Seals of England. The legend, you notice, is free from those foreign titles which overcrowded the names of England, France, and Ireland, upon the last seal we were looking at.

Queen Elizabeth.

James I.—(Second Seal).

We have here James I. with his head tilted slightly on one side, with an expression of countenance reminding one of the man who said that he found much comfort in talking to himself, (1) because he liked talking to a wise man, and (2) because he liked hearing a wise man talk. The name and arms of Scotland appear here for the first time in the Great Seals of England. We are thus reminded of the union of the two crowns. Besides the arms of Scotland the harp for Ireland is also here first introduced in the arms. Notice also the banner of Cadwallader, the last King of the

Britons; and that of Edward the Confessor, the last King of the Saxons, by which James intimated his sovereignty over the peoples of the ancient British and Saxon kings who had formerly reigned in his new kingdom of England and Wales.

The royal arms on this seal approach nearer to those used by Queen Victoria than those borne by many successors of King James I., the only difference being that in the arms of the King, the three fleurs-de-lis of France appear, whilst in those of the Queen they are altogether omitted.

COMMONWEALTH.—(Second Seal.)

A new design tells of a new order of things. No longer do we look upon a King riding in military attire, for no King now rules in these realms. The Commonwealth takes the place of the ancient Monarchy, and for lack of other emblem a map of England, Wales and Ireland appears on the seal. The lions of the Plantagenets disappear from the shield representing England, and it is charged with the cross of St. George. The harp for Ireland appears on another shield. Very significantly appear the ships of the British Fleet, and we may well remember how even in those days when this country was rent by internal strife the brilliant feats performed by the British fleets under Blake, Monk, and Penn, made the name of England famous for valour and victory throughout Europe.

The names of places marked upon this map are of much interest. Vertue, who appears to have had a remarkably clear impression of this seal in 1753, has left us a copper-plate engraving of the seal, from which, if we can rely upon it, it appears that this seal had upwards of 550 names engraved upon it.

The engraving of this seal was executed with great clearness and much artistic ability, notwithstanding the meagreness of the design. The blank spaces on the map are filled up, not only with the ships and coats of arms, but with a compass dial and a dolphin spouting. The outer band bears a series of small oval shields charged with the cross of St. George and the harp of Ireland alternately.

Counter-seal.—In place of a monarch enthroned, we have here a view of the House of Commons in Session, with the Speaker in the chair, a member addressing the House, two clerks at the table, upon which the mace is laid. The execution of this seal may well call forth our admiration. There are more than a hundred heads of members shown; each is carefully and thoughtfully executed. The walls of the chamber are ornamented with spiral pilasters, and representations of fruits and flowers occupy the intervening panels. One of the members sitting in front without his hat is supposed to represent Sir James Harrington. The member addressing the House with his left arm extended, and his hat in his right hand, is said to be Harrison (Cromwell's brother-in-law).

You will notice the legend—"IN THE THIRD YEARE OF FREEDOME BY GOD'S BLESSING RESTORED 1651."

The history of this seal is curious. Simon had made a Great Seal of England for the use of the Commonwealth, in January and February, 1649, and appears to have executed the whole work in less than one month's time. The workmanship seems to have been but rough, and a more carefully finished seal was made about two years later; that is the one you are now looking at. This seal was superseded in 1655, Oliver Cromwell having a seal made for himself as Protector of the Republic; but although superseded the seal was not destroyed, and impressions from it are found attached to documents issued during the Protectorate as late as 1658, but during the interregnum after Richard Cromwell's abdication of power, this seal was brought into use again for more than 12 months, viz., from 14th May, 1659, to 28th May, 1660.

On the 1st May, 1660, Parliament received letters and a declaration from King Charles II. announcing a free and general pardon to all his subjects who, within 40 days, should return to loyalty and obedience to himself, and declaring his readiness, upon demand, to pass such a proclamation under the Great Seal of England. The sealing, however, of such a document had necessarily to be deferred to a future time, as the King's Great Seal was at that time no doubt with him at Breda, beyond the confines of the kingdom, where it could not legally be used, and the Great Seal (at one side of which you are now looking) appended to the writs under which the Parliament had just been summoned, took no notice of the King or of the kingly office, beyond the devout expression of satisfaction that it had been abolished 12 years before.

Early in May it was resolved by Parliament that all proceedings should commence in the King's name, and the question was raised as to what seal should be used. The Commons were for continuing the use of the one you see before you for a short time, but the Lords,

whose existence is ignored by this seal, refused their concurrence, and much wrangling and inconvenience ensued in consequence. What was actually done is not now known, but on the 28th May this seal was solemnly brought into the House of Commons by the Lords Commissioners who had held it and there delivered to the Speaker, and a smith having been sent for, the seal was by him broken in pieces at the Bar in the presence of the House.

Charles II.—(First Seal).

This shows the two sides of all that remains of Charles II.'s first seal. The warrant for this seal was given by the exiled King on 6th June, 1649, at the Hague; 1,000 guilders were promised for it, but this sum was subsequently reduced to 500 guilders. The charter to which it is attached is dated "at St. Germayne en Laye, the 18th day of September, in the first year of our reign." Charles took this seal with him to Scotland, and it is said that he caused it to be carried at the head of his army when he invaded England in 1651. This is no doubt the seal which Clarendon mentions as having been lost at the time of the defeat which Charles sustained at Worcester on the 3rd September in the same year.

The seal itself was probably 6 inches diameter, and bore on one side the King enthroned. We can trace the arms, knees, and orb. The other side no doubt displayed the King on horseback. We can only trace the knee, lower half of leg, and foot of the King.

William and Mary.

The general design and arrangement of this seal is very similar to that which we have already seen of Philip and Mary, whose united rule had threatened the liberties of the people of England as much as that of William and Mary now advanced them. The Nassau Arms displayed upon the small inescutcheon, in the centre of the shield, is the only token that the King was also a foreign prince.

It will be observed that no reference is made to Scotland, either in the arms or the legends in this seal, which I account for thus: The seal must have been commenced immediately upon the entry of William into London in December, 1688, for it was in use by the 11th March, 1689. It was not, however, until the 14th March that the estates of Scotland resolved that William and Mary, King and Queen of England, France, and Ireland, should be declared King and Queen of Scotland, and it was not until the 11th May that they assumed the Crown of Scotland and took the coronation oath before the embassy sent from Scotland for that purpose. You will notice that the harp of Ireland appears in the second and third quarterings of the arms.

Counter-seal.—The sovereigns on horseback passing to the right. The Roman armour of the King, with the long flowing hair or wig of the 17th century, is of course anomalous. Here is a good view of London and the Thames, notice St. Paul's Cathedral, the Monument, the Tower, the Bridge, and the Church of St. Olave.

Anne.—(Second Seal).

This seal was rendered necessary by the Act of Union between England and Scotland, which received the royal assent on 6th March, 1707, and which, amongst other things, provided that from and after the union there should be one Great Seal for the United Kingdom, which was to be different from the Great Seal previously in use in either kingdom. I may, perhaps, here remark, in passing, that from that date the Great Seal of England is also the Great Seal of the United Kingdom of Great Britain and Ireland. Now looking at this seal you cannot fail to be struck with the constant expression of the idea of the union. Look at the impaled arms over the throne, and on the first and fourth quartering on the banner. Look at the union of the crosses of St. George and St. Andrew upon the other banner. Look at the rose and thistle growing on one stem at the commencement of the legend. Look at the roses and thistles on the cornice of the throne, upon the arched recess of the throne, and upon the carpet. Roses and thistles also are placed alternately between each word of the legend. The title "Magnæ Britanniæ Regina" is also new. Another feature in this seal is noteworthy. James II. had in his Great Seal employed caryatic figures as mere artistic supporters of the throne. Queen Anne developed these caryatides into allegorical figures representing Piety, upholding a spired church, and Justice, holding her scales and lictors, rods, and axe. You will notice that Piety takes precedence of Justice. Seeing these figures on the seal of good Queen Anne we cannot help remembering the passionate High Church conflicts which took place during this queen's reign.

Counter-seal.—This is the only seal in the whole series from that of Edward the Confessor to that of Her Majesty our gracious sents Britannia. The idea of the union of England and Scotland is suggested still further. The mpaled Arms of England and

William and Mary.

Queen Anne.

Queen Victoria, in which an allegorical figure by itself is to be found. The figure repre- Scotland; the rose and the thistle both growing on one stem, and flourishing under

one crown: the roses and thistles in the border: all lay stress upon the fact of the union.

QUEEN VICTORIA.

GEORGE III.—(Fifth Seal).

This is the fifth seal of George III., who used to glory in the name of a Briton, and who in the neighbourhood of Windsor was pleased to be regarded as a country gentleman. Beneath the body of the horse is a distant view of Windsor Castle and park. It is the only seal amongst all the Great Seals of England in which Windsor appears.

Counter-seal.—All the seals from that of George I. down to the one at present in use have had composite designs, a mixture of the realistic with the idealistic. This seal illustrates this feature. Here the King is enthroned crowned, in his coronation robes, and wearing the collar, badge and garter of the Most Noble Order of the Garter. On the King's right hand is Justice, with her sword and scales; Wisdom, as symbolized by Minerva, with helmet, olive branch and shield; and Strength, typified by Hercules, with his knotty locks of hair and his lion's skin. On the King's left is Britannia, holding a shield charged with the device of the Union Jack, and Religion, with a long veil, holding a chalice. The British lion is also seen. This is the first time that the cross of St. Patrick appears in the device of the Union Jack (1st August, 1815), that device, as the national flag, having been adopted on 1st January, 1801.

In the exergue of the seal is a palm branch and ancient rudder, suggestive of naval victories, amongst which those of the Nile, Copenhagen, and Trafalgar will for ever be associated with the reign of this king.

After many changes the royal arms are seen in the form with which we are now familiar, with one important exception—the arms of the United Kingdom of Great Britain and Ireland are surmounted by an inescutcheon charged with the arms of Brunswick, Luneburgh, and Saxony, surmounted by the badge of the Arch Treasurer of the Holy Roman Empire, ensigned by the Crown of Hanover.

VICTORIA.—(Third Seal).

The seal of Her Most Gracious Majesty Queen Victoria—whom God preserve. Although this is the third seal which the Queen has had, the design upon it is the same as was upon the first seal which my father had the honour of submitting to Her Majesty upwards of 62 years ago, an interval during which the national prosperity and power have increased with wondrous leaps and bounds, that increase throughout those many years having been wisely watched over, directed and welded together by the ever-ready and gracious personal interest and sympathy of that august sovereign whose youthful portrait appears upon this seal.

Counter-seal.—In this counter-seal which you have already seen I would now ask your attention to only one point, the royal arms relieved of the Hanoverian inescutcheon. They stand with greater dignity from their greater simplicity; but the removal of the Hanoverian arms signifies also the separation of a kingdom and its people from under the sway of the Sovereign of England. Any regret at such a loss may, however, be at once dispelled when we remember that the Queen of England now rules territories of more than 9,000,000 square miles, and over free and prosperous peoples exceeding 300,000,000 in number—an extent of countries far vaster and of races far more numerous than those ruled over by any of Her Majesty's royal predecessors, whose might and splendour have in some degree been reflected in this long and uninterrupted series of the great seals of England, at which we have been taking some brief glances to-night.

[The Illustrations of this paper are copied (by permission) from the plates in "The Great Seals of England," London, 1887, by the late Alfred B. Wyon and Allan Wyon.]

DISCUSSION.

The CHAIRMAN, in inviting discussion, remarked that though the subject of the paper was the Great Seals of England, it would not be out of place for anyone who had anything to say on the subject of seals in general to bring it forward. The Great Seals were chiefly valuable as historical documents, and though they did, in a way, represent the progress of the arts of the time in architecture, armour, and other accessories, their design was to a certain extent fixed and immutable. On the other hand, in the personal seals used for many centuries by the nobility, gentry, and others, the individual tastes of the owner could be represented, and in some cases these seals were very valuable also as documentary history, showing the manners, architecture, and costume of the period. At the present day, when mechanical appliances had superseded a great deal of the labour expended on matters of fine art, when the type-writer and the adhesive envelope had between them completely destroyed the arts of caligraphy and seal engraving, it might be hoped that the new movement for promoting design of the finest kind in the various arts might be extended to the beautiful art of which Mr. Wyon had given so many beautiful specimens, and which was now falling so much into disuse.

Rev. J. O. BEVAN said he was sure everyone present must have enjoyed this paper, which was delightful, not only for its information on seal engraving, but for its historical allusions, which derived additional value from the personality of the author. He should like to ask if all these seals were used as moulds, and also if any of them were still in existence. He presumed that on the death of a sove-

reign, or when a new seal was introduced, the original seal was destroyed. There had been no reference made to any seal of James II.; it was commonly reported that when he left England he threw the Great Seal into the Thames, and that it was afterwards recovered by a fisherman; he should like to know if Mr. Wyon could confirm that story. He was recently in the library of Ely Cathedral examining some of the old *congés d'elire*, which in old days were always made out under the Great Seal. Within 25 or 30 years, the Great Seal was no longer used, but was replaced by a wafer.

The CHAIRMAN said he thought the last point was rather outside the scope of the paper, and was treading on diplomatic ground. If there were no other remarks to be made, he would proceed to the pleasant duty of proposing a vote of thanks to Mr. Wyon for his valuable paper. Before doing so, however, he would exhibit to the Society a very curious design for a Great Seal, which was prepared for George I. It belonged to her Majesty, who had given him her gracious permission to exhibit it. It was made for the obverse of a Great Seal, representing George I. seated on his throne, and he had on either side figures representing justice, valour, military strength, and legal power, and underneath his feet was a nude figure, prostrate, on which he was trampling, which held a serpent in its hands. This might be taken to represent the King trampling on all opposition to his right as King of England, or it might represent particularly the triumph of the King over the rising of the Jacobites. The design, however, was never carried out. The gure of rebellion was not used at all by George I., but it appeared, not quite so prominently, under the feet of his successor, George II. He could hardly say why it was not carried out; it might be, that it was in too high relief, or it might be that the representation of the particular figure was not considered advisable at the time by the King's Ministers. He did not know who was the designer, but Mr. Wyon, in his important book on the Great Seals, mentioned two men, Gerard and Seton, who about that time were known as seal engravers. Her Majesty had been very pleased to lend the design for exhibition at the Society, in which she had taken a great interest from the time of the Prince Consort, who was its president, and gave to it so much of his valuable time and indomitable energy.

Mr. J. PENNELL asked if the seals of Charles I., Cromwell, and Charles II., exhibited as such in the British Museum, were really the Great Seals of those rulers, as they had not been referred to in the paper?

The CHAIRMAN said they were impressions of Great Seals. He was for a long time in the MSS. Department of the British Museum and knew them very well, and he might safely say they were authentic impressions.

The CHAIRMAN, in putting the vote, which was carried unanimously, referred to Mr. Wyon's hereditary connection with this subject, about which he knew more than anyone, and again expressed a hope that a new impetus would be given to the declining art of seal engraving.

Mr. WYON, in responding, said he had been familiar with facts relating to these Great Seals for so long that he almost felt it required an apology for bringing them before the notice of others. They must all feel deeply grateful to Her Majesty for graciously permitting the exhibition of this design for a Great Seal. In answer to the question as to the material in which impressions were taken, when attached to documents, charters, &c., he said it was largely composed of wax, but other things had been introduced, especially within the last 150 years; resin and other substances, which gave a certain brittleness to the impressions, and caused them in many cases not to last so long as many impresssons taken five, six, or seven hundred years ago. The quantity of wax required was so great that they had to eke it out with other materials, and that also was the cause of an Act of Parliament being passed some 20 years ago, by which it was provided that in future there should be, in addition to the large silver seal, a small seal, to be used with a wafer, called the Small Great Seal, and that was now used on letters of *congé d'elire* and other matters. That evening he had only referred to a few of the leading features of the Great Seals; there were many other matters he might have referred to, amongst them the Seal of James II., which was no doubt found in the Thames, and taken to the King in Council, William III. The Great Seals were mostly made in silver, one was in gold, and one or two were in base metal. As soon as a new seal was brought in, and Her Majestry had laid her hands on it in Council, it became the Great Seal, and the old one was defaced. Formerly it was broken to pieces, but of late years it had been simply defaced by making one or two marks upon it with a pointed hammer. The old seal then became the property of the Lord Chancellor for the time being, and was one of his perquisites. He had seen the remains of a Great Seal of Queen Mary, which was made into a cup for Sir Nicholas Bacon, and was exhibited at the Society of Antiquaries, but as a general rule they went into the melting-pot.

ERRATA.—The following corrections are required in the report of Dr. Schlich's speech in the discussion on "National Forestry" in the last number of the *Journal*:—

Page 34, col. 2, line 4, *for* below *read* between.
————, line 24, *for* 8,000,000 *read* 6,000,000.
————, last line, *for* 20 per cent. *read* 26 per cent.
Page 35, col. 1, line 6, *for* 1,800 *read* 1,800,000.

Miscellaneous.

MANGANESE MINING IN BRAZIL.

Another mine of manganese has been lately opened up in the State of Bahia, making, at present, two mines in operation. They are each situated about 26 kilometres (16 miles) from the town of Nazareth, near the village of Santo Antonio de Jesus. Nazareth is a town of 18,000 inhabitants, situated near the mouth of the Jaguaripe river, 102 kilometres (63 miles) from the city of Bahia. A small side-wheel steamer plies between the two places. The first of the mines to be opened is owned by a Brazilian firm, and has been in operation about two years. It contains, according to the United States Consul at Bahia, several times more ore than its neighbour to the south. The ore occurs in seams and pockets of various thicknesses, appearing in some places as surface outcropping, though the greater part of it lies at a depth of six feet or more below the surface, while a large seam has been discovered at a considerable distance below, following the steep incline of the hill. This is worked through a shaft sunk from the hilltop and tunnels running into the shaft from the hillside. The ore is picked, blasted, and loaded on ore cars and taken to a large shed, where women and children are employed to sort and break off enough of the poorer quality to make the balance marketable. Here it is loaded on larger ore cars and conducted by a road winding in and out the hills for a couple of miles, to the railroad, where it is loaded on the flat cars. The empty ore cars are hauled by mules back to the mines. The other mine, which is owned by an English firm, shipped its first cargo in May, 1899. To work it the earth is first removed and dumped over the hillside, which almost amounts to a cliff. This exposes large areas of manganese, which is then removed with a pick, crowbar, or blast, and loaded in ore cars, which are run to a central station, where it is sorted, as at the other mine. From this central station it is taken to the railway, about 920 feet distant. The amount of ore available cannot be estimated with any degree of accuracy, on account of the irregularity of its occurrence. The estimated yield of the mine just opened was first placed at 176,000 tons, but it is understood that more than this amount is now expected. The other mine is acknowledged to contain at least three times as much, so the total quantity in sight can be placed at 700,000 tons, with the chances of greatly exceeding this amount. Consul Furniss has been informed that the land in the vicinity of these two mines has been prospected and that the manganese has been found, poorer in quality and much less in quantity than that now being worked. The ore, as found, is the hydrous oxide of manganese, known as "psilomelane." It is associated with schist rock, and averages about 42 per cent. of pure oxide of manganese. Its principal impurity, which affects its commercial value, is the 11 to 12 per cent. of silica which it contains. It has also from 3 to 4 per cent. of oxide of iron; fractional percentages of lead, lime, sulphur, cobalt, phosphorus and copper; between 12 and 13 per cent. of alumina and from 5 to 7 per cent. of combined water. The ore is removed and loaded under the inspection of the State government, which exacts an export duty of 7 per cent. of the market value of the ore per ton.

CACAO CULTURE IN ECUADOR.

The history of Ecuador does not record when the cacao plant was introduced into the country, but it is stated that the production in 1741 was from 35,000 to 40,000 "cargas" of 81 lbs, each. It is believed that cacao came originally from Mexico, where it was cultivated by the Aztecs long prior to the Spanish conquest. In Mexico it was called "cacari" or "cascara quahuitl," and the product was called "chocolatl," from which the word chocolate is derived. It is produced in five provinces of the coast of Ecuador, Los Rios, El Oro, Guayas, Manavi, and Esmeraldas. The soil best adapted for for cacao plantations in one that is deep and moist, the root of the tree growing vertically downward to a considerable depth. Silicious clay is especially preferred on account of the phosphoric acid and potash required by the bean. Banks of navigable rivers are selected generally because of the transportation facilities, but important plantations are found at considerable distances from waterways. Cacao is planted from fresh seeds. Four or five are put in each hole, which are five yards apart, in rows. Formerly they were two or three yards apart, but experience has shown that this method does not give the plant sufficient air, light, and nourishment. The United States Consul-General at Guayaquil says that the cultivation of cacao in Ecuador is limited to caring for the plant until it reaches maturity, then cleaning and weeding once a year. In the first few years, the plant is pruned occasionally, in order that it may "run to fruit" more quickly. Manures have never been used, even when the ground has been cultivated over a century, and no irrigation is practised. The sediment, spread over the lands by the rains during the rainy season, and the decaying vegetation, appear to afford sufficient nutriment. In some haciendas, however, the proprietors pile up leaves and other vegetable matter found in the vicinity of the tree at its foot, and also rub down the bark with coarse cloth to destroy the adhering parasites. In the primitive manner in which it is grown and harvested, cacao yields a good return on the capital invested, but if scientific methods were adopted there is no doubt that the increase in production would be large. In the sixth or seventh year the tree commences to bear, but the pods at this time are very small and scarcely repay the effort to gather them.

In the tenth year the tree reaches full maturity. It then produces on an average 1 lb. of dry cocoa of good quality. There are many trees which produce more, especially those which are isolated, some of which have yielded at one picking as much as 7 or 8 lbs. In the province of Oro (Machala), $1\frac{1}{2}$ to 2 lbs. per tree is the estimated yield. The tree is in bloom during the entire year, but most of the blossoms fall before fructification, which occurs twice a year, the time varying with the locality. The cacao tree grows to a height of 20 or 30 feet; its leaves are evergreen and lanceolated in form; the base of the main trunk attains a thickness of 8 to 10 inches; the bark is hard and of greenish coffee colour. The blossom is very small, pinkish white and wax-like in appearance. It grows directly out of the main trunk and branches. If it fructifies, the petals fall off, and from the stamens, in the course of from fifty to seventy days, an oblong pod is developed. This pod is of goldern colour, and contains some twenty to thirty-five grains of cacao, enveloped in a gummy liquid which coagulates on exposure to air. The outer rind of this pod is dark or golden yellow in colour, and very hard, a sharp instrument being necessary to cut it open. Its size varies according to the kind of cacao, from 8 to 15 inches long by 2 to 6 inches thick. The outer rind is marked by longitudinal furrows, more or less pronounced, which indicate the interior arrangement of the seeds. Both the outer rind and the gummy contents of the pod are porous, and blacken in colour as soon as picked, and in Ecuador are of use only to fertilise the soil upon which they are cast. As soon as the pods begin to ripen, they are removed with pruning knives, very sharp, and attached to the ends of long poles, which are lengthened by joints as often as required. As the twigs are very tough, the blow with this instrument must be strong and well aimed, and the labourers must be experienced on account of the particular skill that is required and the fatigue that attends handling heavy poles sometimes 30 feet high, with the face continually upturned. Whenever they can be reached the pods are cut off with a machete. A good deal of cacao is lost by the carelessness of the labourer, and his disinclination to deal with the pods in the upper branches. The pods are heaped in piles by one set of labourers, while another cuts them open and extracts the contents. A sharp pruning knife is used, and the seeds are often damaged through carelessness. For extracting the gummy substance and the seeds, an implement made of an ox rib is used. The drying is done on open platforms made of split bamboo and palms, where the cacao is exposed to the sun during three or four days, and in order that it may dry uniformly and well, labourers are employed to tread it out with bare feet. If not well dried the bean is apt to ferment; and if excessively dried it shrinks and finally turns black. The dryers are provided with covers for protection against rain. Attempts have been made to introduce drying machinery (steam), but at present not one plantation in Ecuador uses it. When dried in the primitive fashion stated, a great deal of pulp yet adhering to the grain, the cacao is put into sacks and sent to Guayaquil to be sold in its natural state. Some merchants, it is said, attempt to deceive the buyer by washing an inferior bean in achiote, which gives the skin the appearance of first-class cacao, but this practice is severely condemned by honest merchants, and is seldom followed, nor is reddish earth used in Ecuador as it is elsewhere for the purpose of preserving the grain from decomposition, and of increasing its weight. Reaching Guayaquil, the cacao is subjected to the cleaning process. Splinters, dirt, and defective beans are eliminated, and the adhering clusters of beans broken apart and dried several times before shipment. During this process the cacao loses 4 to 5 per cent. in weight. The sacks for foreign shipment contains from 60 to 70 kilogrammes (132 to 154 lbs.) net. The largest portion of the crop is bought in advance by Guayaquil merchants engaged in this business, who lend considerable sums of money during the year for current expenses of cacao estates. Large capital is necessary, and the number of merchants engaged in the business is limited. The profits of a plantation depend chiefly on the quality of the land, management, and proximity to market; but it may be reckoned approximately at from 40 to 50 per cent. per annum on the capital invested which will continue for an indefinite period, cacao trees lasting for several generations. The price of land varies greatly, and depends on the caprice or need of the seller. Land adapted to cacao cultivation covers an area of some 19,600 square miles in the coast provinces of Ecuador. A very small proportion of available land is now under cultivation, although there are large tracts adjoining important estates. The chief impediment to the rapid development of cacao plantations in Ecuador is the system of "peonage conciertos," or slavery in all but name, which is in vogue, whereby labourers are bought and sold openly for debts. The production of cacao in Ecuador has been increasing since 1836, and the crop in 1899 is expected to be nearly 30,000 tons, the chief producing province being Los Rios, these following in their order of their importance: Guazas, El Oro, Manavi, and Esmeraldas.

Correspondence.

NATIONAL FORESTRY.

SIR C. M. KENNEDY, K.C.M.G., C.B., writes as follows, under date of the 25th ult.:—

"I should be glad to offer a few remarks in connection with Mr. Hutchins's valuable and interesting paper, read on the 22nd inst.; time did not permit these observations to be made in the course of the discussion. The paper dwells on Indian, Colonial,

and Continental experience; it, however, hardly brings up to date the account of what has been done in this country, nor does it fully describe the conditions which now prevail here. It is to be remarked in passing that the nature of the soil and the rate of wages for forestry work differ widely in the localities adverted to; and that, in order to attain practical results, the facts of the case in each county, where public interests are to be served, should be set forth in detail, and with due regard to local circumstances. In the West of England, for instance, no forestry could make trees grow up to good timber on high ground exposed to the S.W. sea winds. Forestry in the United Kingdom has been treated in the reports of the Commissioners for Woods and Forests, by the Institution of Civil Engineers, and by the Royal Scottish Arboriculture Society. Space will not allow of an adequate analysis of these papers. It must suffice to say that the views of the present Government on this question may be taken on the statement made by Mr. W. N. Long, the President of the Board of Agriculture, at a Conference held in Edinburgh on the 23rd of October, 1895. Mr. Long recognised that in this matter 'something more is wanted than mere schools for education.' He said, 'I do admit that the Board of Agriculture is not as well provided with advisers upon arboriculture and forestry as they ought to be, and I should like to see some improvement in this respect.' And he admitted that 'private owners cannot be expected to embark upon experiments which may or may not be successful, and which would be conducted largely for the benefit of the public.'

"As to the steps to be adopted, Mr. Long seemed to be willing to appoint correspondents in different centres to bring the wants of these localities before the Board of Agriculture, and recommended that in the first instance County Councils should be induced to apply a portion of the funds placed at their disposal for technical education to forestry instruction and use. For any large or immediate application of Parliamentary funds, he said, very candidly and truly, that the previous assent of the Treasury must be obtained; and while for a time some interests may be injured by the reluctance of the Treasury to sanction useful grants, yet it is to be remembered that the general interests of the country are well served by the difficulty made by the Treasury against too ready compliance with demands upon the Exchequer. It must not be overlooked that, under the provisions of the Improvement of Lands Act passed by Parliament at the instance of Mr. Long in this present year, a Londoner is granted a prolonged period for the repayment of moneys borrowed for the planting of woods and trees when once they have survived the critical period of growth and become well established.

"I beg to suggest that the best course to be adopted, in the interests of national forestry, is that the several societies which have taken up the subject should consult together, in order to secure united action and co-operation: that they should thus agree as to what is wanted to be done in the first instance and ultimately. It must be borne in mind that large and complicated schemes rarely meet with support either from the country or the Government. The Board of Agriculture is friendly. As soon as the persons and societies interested bring their views and recommendations into line, these proposals might be placed before the Board of Agriculture, and by friendly communication national requirements could be discussed, considered, and the best means be agreed upon for the purpose of bringing them before the country and Parliament. Possibly a Royal or Departmental Commission would be the most effectual means of putting into definite shape proposals on a subject of this national importance, and of conferring on them the authority which is needed to ensure attention from the Treasury and Parliament.

"Mr. Hutchins's paper is very appropriate (especially in this early date in the Society's Session) in bringing this subject into serious consideration. It must, however, if any practical result is to follow, be seconded and strongly supported by the united co-operation of all who are concerned in this question.

"The report of the deputation to Mr. Long at the Scottish office, Edinburgh, is sent to the editor of the *Journal* for convenience of reference. The Society of Arts may, I venture to suggest, resume its labours in furtherance of this national interest with great advantage to the public welfare."

Obituary.

Thomas Henry Ismay, J.P., D.L.—Mr. Ismay, chairman of the White Star Company, died on 23rd November, at his residence Dawport, near Birkenhead, after a long illness. He was born on January 7th, 1837, at Maryport, Cumberland, where his father, Joseph Ismay, was a shipbuilder and shipowner. At sixteen years of age, young Ismay was apprenticed to Messrs. Imrie and Tomlinson, shipowners of Liverpool. After the expiration of his apprenticeship he gained experience by extensive travels, sailing round Cape Horn and visiting the ports of Chile, Peru, Bolivia, &c. On his return to Liverpool he started business on his own account. In 1867 he acquired the important enterprise of the White Star line of Australian clippers. In 1868, Mr. Ismay with a former fellow apprentice, Mr. William Imrie, formed the Oceanic Steamship Company, and in 1870 the firm decided upon entering into the competition for the Atlantic trade while still continuing the Australian. Mr. Ismay retired from the firm of Ismay, Imrie, and Co., in 1892, but retained the chair-

nanship of the White Star Company. He served on several important Royal Commissions, and was a director of the London and North-Western Railway. He was elected a member of the Society of Arts in 1892.

Henry Vaughan.—Mr. Vaughan, the distinguished connoisseur and art collector, died at his residence in 28, Cumberland-terrace, Regent's-park, on the 26th November, in his 91st year. He was elected a member of the Society of Arts in 1862, and in 1864 and 1870 he was a member of the Council, and auditor in the years 1868 and 1869. Mr. Vaughan presented a fine series of Michael Angelo's drawings to the print room of the British Museum, and Constable's grand picture the "Hay Wain" in the National Gallery was his gift. He also frequently lent fine examples of drawings from his portfolios to the Winter Exhibitions of the Royal Academy.

General Notes.

Nettle Fibre in Germany.—Nettle fibre has of late come greatly into favour in the manufacture of fine yarns and tissues in Germany. In that country, according to the United States Consul at Glauchau, there are factories which use these fibres, both in spinning and also for ulterior purposes. In nettle spinning alone, over 10,000 spindles and some hundred workmen are employed. The raw material is imported almost exclusively from China, whence from 660,000 to 800,000 lbs. are annually sent to Germany. Nettle fibre produces one of the finest tissues obtainable from any known kind of vegetable fibre. In view of the importance which this seems likely to attain in connection with the weaving industries, it is intended to introduce the cultivation of nettles, if possible, into the Cameroons. The idea is to prepare the products of this experimental culture at the place where they are obtained, and test them in German factories. Should favourable results follow from these experiments, it is intended to organise nettle-growing enterprises on an extensive scale.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings at 8 o'clock:—

December 6.—"Artificial Silk." By Joseph Cash. Sir Thomas Wardle will preside.

December 13.—"Sea Angling and Legislation." By F. G. Aflalo. J. W. Willis Bund will preside.

December 20.—"Bi-Manual Training by Blackboard Drawing." By H. Bloomfield Bare, F.R.I.B.A. Walter Crane will preside.

Papers for meetings after Christmas:—

"Electric Traction." Charles H. Gadsby.

"Steam Motors for Common Roads." By John I. Thornycroft, F.R.S., M.Inst.C.E.

"The Diffraction Process of Colour Photography." By Professor R. W. Wood.

"Coal in South-Eastern England." By Professor W. Boyd Dawkins, M.A., F.R.S.

"A National Repository of Science and Art." By Professor W. M. Flinders Petrie, D.C.L.

"The Electrical Induction Motor on Mountain Railways." By Professor Charles A. Carus-Wilson, M.A.

"Ventilation without Draughts." By Arthur Rigg.

"The Undeveloped Resources of the Bolivian Andes." By Sir Martin Conway.

"The Orloff Process of Colour Printing." By W. H. Ward.

"Continuation School Work in Rural Districts." By H. Macan.

"Artistic Copyright." By Edwin Bale.

"Local Government and its relation to Parish Water Supply and Sewerage." By W. O. E. Meade-King, M.Inst.C.E.

Indian Section.

The meetings of this Section will take place on the following Thursday afternoons at 4.30.

December 14, January 18, February 8, March 8, April 26, May 17.

December 14.—"Round about the Andamans and Nicobars." By Colonel R. C. Temple, C.I.E. The Right Hon. Henry H. Fowler, G.C.S.I., M.P., will preside.

"Our Work in India in the 19th Century." By Sir William Lee-Warner, K.C.S.I., M.A.

"The Industrial Development of India." By J. A. Baines, C.S.I.

"New Projects of Railway Communication with India." By J. M. Maclean, M.P.

"Indian and English Criminal Procedure." By Sir John Scott, K.C.M.G., D.C.L.

Foreign and Colonial Section.

The meetings of this Section will take place on Thursday afternoon, February 1, and Tuesday afternoons, February 27 and March 20, at 4.30 or 8 o'clock:—

February 1.—"The Century in our Colonies." By The Right Hon. Sir Charles Dilke, Bart., M.P.

Applied Art Section.

The meetings of this Section will take place on the following Tuesday evenings at 8 o'clock:—

January 30, February 13, March 13, April 3, May 8, 29.

Cantor Lectures.

The following courses of Cantor lectures will be delivered on Monday evenings at 8 o'clock:—

Henry Hardinge Cunynghame, "Art Enamelling upon Metals." Four Lectures.

Lecture III.—December 4.

The method of making enamels—Fluxes—The metallic oxides.

Lecture IV.—December 11.

The application of enamel to jewellery—Gold working—Gilding.

Bennett H. Brough, "Metalliferous Deposits." Four Lectures.
January 22, 29, February, 5, 12.

E. Sanger Shepherd, "Photography of Colour." Four Lectures.
March 5, 12, 19, 26.

Major Philip Cardew, R.E., "The Control, Regulation, and Measurement of the Supply of Electrical Energy." Three Lectures.
May 7, 14, 21.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor lectures.) Mr. Henry Hardinge Cunynghame, "Art Enamelling upon Metals." (Lecture III.)

Farmers' Club, Salisbury Hotel, Salisbury-square, E.C., 4 p.m. 1. Annual General Meeting. 2. Mr. H. Layton Blunt, "The Future of Agricultural Labour."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Gordon Harris, "Water Supply to Country Mansions and Estates."

British Architects, 9, Conduit-street, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p.m. Mr. R. H. Mathews, "Pictorial Art among the Australian Aborigines."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Lewis F. Day, "Stained Glass."

Tuesday, Dec. 5...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Messrs. Dalrymple-Hay and Jenkin's paper, "The Waterloo and City Railway, and its Electrical Equipment." 2. Mr. C. Newton Russell, "Combined Refuse-Destructors and Power-Plants."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. F. H. Evans, "Lincoln Cathedral."

Biblical Archæology, 37, Great Russell-street, W.C., 8 p.m.

Colonial, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Hon. Septimus Stephen, "New South Wales—Past and Present."

Wednesday, Dec. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Joseph Cash, "Artificial Silk."

Geological, Burlington-house, W., 8 p.m.

Archæological Inst., 20, Hanover-square, W., 4 p.m.

Entomological, 11, Chandos-street, W., 7 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Discussion on paper by Mr. J. C. Chapman, "Some Aspects of Disconformity and the Judicial Functions of the Patent-office in regard to same and other matters." 2. Mr. A. V. Newton, "Hints for the Development of the Chartered Institute of Patent Agents." 3. Discussion on the President's Opening Address."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Central Chamber of Agriculture (at the House of the Society of Arts), 11 a.m.

Thursday, Dec. 7...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. J. W. Fawcett, "Some Vegetable Poisons used for the Capture of Fish by the Australian Aborigines." 2. Mr. G. M. Thomson, "Some New Zealand Schizopoda." 3. Mr. H. M. Bernard, "The Structure of Porites."

Chemical, Burlington-house, W., 8 p.m. 1. Messrs. H. J. H. Fenton and H. O. Jones, "The Oxidation of certain Organic Acids in presence of Iron." 2. Drs. A. W. Crossley and H. R. LeSueur, "The Determination of the Constitution of Fatty Acids." 3. Mr. F. R. Mallet, "Sulphates of the Form R'_2SO_4, $2M''SO_4$, especially those of Isometric Crystallisation."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. F. A. Cox, "The Madrigal in Shakespeare's Time." (With Vocal Illustrations.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. John Holliday, "The Cost of Steam Raising." 2. Adjourned Discussion on paper by Mr. R. E. Crompton, "Influence of Cheap Fuels on the Cost of Electrical Energy."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. B. Worsfold, "England in South Africa" (Lecture V.).

Friday, Dec. 8 ... Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 8 p.m. Prof. William Ripper, "A Continuous Mean-Pressure Indicator for Steam Engines."

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical (in the Physical Laboratory of the City and Guilds' Technical College, Leonard-street, Finsbury, E.C.), 5 p.m. 1. Prof. Silvanus Thompson, "Cylindrical Lenses." 2. Mr. T. H. Blakesley, "Exact Formulæ for Lenses." 3. Prof. Silvanus Thompson, "An Organic Compound of great Double-Refraction."

Saturday, Dec. 9 ..Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

North-East Coast Institute of Engineers and Shipbuilders, Sunderland, 7½ p.m. Mr. J. S. Postgate, "Ship Resistances."

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FRIDAY, DECEMBER 8, 1899.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, 1900, at 7 o'clock, by HERBERT JACKSON, on "The Phenomena of Phosphorescence."

The lectures will commence at 7 o'clock. Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions each member is entitled to a ticket admitting two children and an adult. Members requiring these tickets should apply at once.

APPLIED ART SECTION.

A meeting of the Committee of the Applied Art Section was held on Wednesday afternoon, 29th November. Present: Lewis F. Day (in the chair), A. Lasenby Liberty, Sir Villiers Lister, K.C.M.G., Sir Walter S. Prideaux, Vincent J. Robinson, C.S.I., John Sparkes, R. Phené Spiers, William Luson Thomas, with Sir Henry Trueman Wood, Secretary to the Society, and Henry B. Wheatley, Secretary to the Section.

CANTOR LECTURES.

On Monday evening, 4th inst., Mr. HENRY HARDINGE CUNYNGHAME delivered the third lecture of his course on "Art Enamelling upon Metals."

The lectures will be printed in the *Journal* during the Christmas recess.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by Members on application to the Secretary.

Proceedings of the Society.

FOURTH ORDINARY MEETING.

Wednesday, December 6, 1899; Sir THOMAS WARDLE in the chair.

The following candidates were proposed for election as members of the Society:—

Bevington, Colonel Samuel Bourne, J.P., 42, St. Thomas'-street, S.E.
Burbery, Joseph Stone, Trent-house, Cowes, Isle of Wight.
Gatacre, M. Leicester S., Charlton, Weston-Super-Mare.
Harris, C. T., Holly-lodge, Denmark-hill, S.E.
Henry, J. S., 287 to 291, Old-street, E.C.
Standage, Henry Charles, 21, George-road, Witton, Birmingham.
Tebb, Robert Palmer, Enderfield, Chislehurst, Kent.

The following candidates were balloted for and duly elected members of the Society:—

Daymond, John, Dunrobin, Bedford-hill, Tooting-common, S.W.
Garrett, Albert E., 127, Lothair-road, Finsbury-park, N.
King, Daniel, 14, St. Mary-axe, E.C.
Moorhead, James, Exchange-buildings, Cardiff.
Nariman, Bahadur K., L.R.C.P., B.G.J.P. Railway, Bhavnagar, Bombay.
Oakey, Herbert, Caton-lodge, 13, High-road, Streatham, S.W., and Wellington-mills, Westminster-bridge-road, S.E.
Ravenshaw, Albert Francis, 102, Croxted-road, Dulwich, S.E.
Wilkinson, Charles Herbert, Halton-house, Cheshunt, Herts.

The paper read was—

ARTIFICIAL SILK.

By JOSEPH CASH.

It is a trite saying that all inventions are creatures of evolution. I shall give a short description, therefore, of a few attempts to produce the appearance of silk before the perfected artificial article of to-day became an established fact. Some were partially successful

in effect and others have been a pronounced commercial success, adding greatly to the variety of the cheaper textile fabrics.

Spun Glass.

Spun Glass is probably the earliest production which resembles natural silk. The thread is perfectly flexible, possessing great brilliancy, and is produced in a variety of colours. The feel to the touch is soft and smooth; it can be woven into many textiles, and is specially useful in millinery articles where warmth is not a necessary adjunct.

Polished or Diamond Cotton.

Polished or Diamond Cotton is a lustrous looking article, and in the fine sizes, or counts as it is called in the trade, is silky in appearance and soft to the touch. An enormous trade is done in this article for dress goods, as it is often used in combination with silk. The process of producing it is very simple, waxy and starchy substances being put on the thread in a liquid emulsion; the yarn is then transferred to a polishing machine with rapid revolving brushes, which completes the process.

Mercerised Cotton.

A process for giving a silky appearance to cotton has lately been brought to the notice of manufacturers with very satisfactory results. The process is practised by most cotton dyers, there being no valid patent. The name is derived from the inventor, John Mercer, who discovered the process in 1844. The cotton yarn is passed through strong solutions of caustic lye. The yarn must be at full tension during the whole operation, even until it is quite dry. Mercer's theory of the action of caustic soda is that received to-day, viz., that the *mercerised* yarn is a hydrate of cellulose, the first action being the formation of a compound of sodium oxide and cellulose. The subsequent washing replaces the sodium oxide by water, which is held by the cellulose like the other metallic oxide. Such a theory as this gives us very little light on the matter, and does not explain the difference between the hydrate formed and the original hydrate. It can be dyed any colour without materially affecting the brilliancy which has been imparted to it by the mercerising process.

Vandura Silk.

Vandura Silk is a gelatine thread, therefore animal in its composition, and more nearly allied to natural silk than any of the imitations already described; Adam Millar, the inventor and patentee, quite recently died, unfortunately before he attained the perfection at which he was aiming. The manufacture of the silk is conducted by pressing an aqueous solution of gelatine through a very fine glass capillary tube. On issuing therefrom the thread is laid on an endless band which carries it some distance to allow it to dry; from the end of this band or table it is wound on to bobbins ready to put into skeins for the manufacturer. I am of the opinion that this article will not meet with a very great commercial success, as, the gelatine being soluble in water, it cannot be dyed after the thread is made. Therefore the solution of gelatine must be coloured to the required shade before being spun. The impracticability of this is manifest when I tell you there are at least fifty colours with fifty shades in each colour, and at least four sizes of thread; the stock would be at least 990 lbs., if only 1 lb. of each size and colour was made.

Mr. Millar described his process as follows:—

"I take 4 lbs. weight of the best gelatin I can get, break it up into granular pieces such as will pass through a riddle of four meshes to an inch, 16 meshes per square inch. I place the broken gelatin in a melting vessel, and add 2 lbs. of cold water, and stir it well, put on a cover or lid and let it stand for one hour. The vessel is next placed in a can of hot water and kept heated to 120° Fahr. for another hour, stirring it once or twice. By the end of the second hour I have a solution of gelatin of uniform consistency, containing 66 per cent. of gelatin and only 33 per cent. of water—a very thick solution.

"The group of filaments are next twisted together and spread out in a thin layer on an open metal reel, about 1 foot in diameter. A number of these reels of plain gelatin yarn are now placed in a chamber in which a very small quantity of formaldehyde has been poured, and is therefore filled with formalin vapour—about 80 minims of formalin to a space of 10 cubic feet. An exposure to this vapour at ordinary temperature completely changes the gelatin. It is no longer soluble, even in boiling water, nor in any solvent that I have tried, and has a splendid lustre.

"The reels are hung up to allow all smell of the formalin to disappear, and the artificial silk is finished, needing only to be wound on to bobbins for the convenience of handling before it gets into the hands of the textile manufacturer.

"You will have noticed that this process for producing an artificial silk, which I have described, is a chemical process, but it is also a mechanical process. The successful substitute for the product of the silkworm must be a yarn made up of very fine filaments, so as to be smooth to the touch, and so pliable as to feel soft to the handling. The material of real silk,

when obtained in somewhat thick threads, is neither smooth nor pliable, but is very harsh to the touch, and very stiff in handling. Indeed, to one not acquainted with the fact, it is very difficult to understand how the softest of velvets are produced from this harsh, stiff material—so stiff that it can hardly be tied into a knot. It is this extreme fineness of filament required in any artificial process which makes the mechanical part of the process such a dominating factor in the commercial aspect of the case.

"The nipples of my machine have a bore of one-hundredth of an inch, but the filaments drawn from these nipples may be only one-thousandth of an inch in diameter. The flow of the liquid through the nipples is regulated by air pressure. An india-rubber pipe leads from a receiver of compressed air, and has its other end attached to a small pipe fixed to the air-tight cover of the cylinder which contains the gelatin solution. The endless travelling band, on which the threads fall, and by which they are drawn away rapidly, moves at a uniform rate—say 60 yards per second, but if the speed be increased to 120 yards the filament would be twice the fineness; the same result is obtained by reducing the pressure in the air receiver or reservoir."

Collodion Silk.

Several persons have given their attention to the perfecting of the manufacture of collodion silk, among whom are Count Hilaire de Chardonnet, Dr. Lehner, and Nobel of cordite fame. The different systems vary only in detail, so I shall describe the most successful one, known as the *Chardonnet silk*. I first saw this artificial silk at the Paris Exhibition of 1889, where it obtained a "Grand Prix." Previous exhibits were made of artificial silk in 1878, but no commercial success was attained for many years.

A public company for the manufacture of artificial silk by the Chardonnet process has been formed in England. The factory, extending over two acres, is at Wolston, on the river Avon, near Coventry, and will be capable when filled with machinery of producing 7,000 lbs. of silk per week.

The first stage of manufacture is the *nitration of cotton* or wood pulp producing pyroxyline, discovered by Pelouze in 1838. The greatest care must be employed in conducting this operation, as it is the most important one in the whole process; mistakes sometimes even occur at the long established factory at Besançon in France. The process of nitration of cellulose is the displacement of a few molecules of hydrogen by nitric peroxide. There are several varieties of pyroxyline which are obtained by using different mixtures of acid. The highest nitro-cotton product, gun-cotton or tri-nitrocellulose, is useless for the manufacture of artificial silk, as it is insoluble in a mixture of alcohol and ether. To obtain the pyroxyline or binitrocellulose suitable for the production of collodion for our purpose, a mixture of 15 volumes of sulphuric (H_2SO_4) and 12 volumes of nitric acid (HNO_3) is made; two pounds of bleached raw cotton is then taken and put into an earthenware jar with about three gallons of mixed acid; this is left standing for four to five hours, when the nitration is complete. The chemical reaction may be expressed by the following formulæ:—

$$C_6H_{10}O_5 + 2HNO_3 + H_2SO_4 =$$
$$C_6H_8\,2(NO_2)\,O_5 + 2H_2O + H_2SO_4.$$

The object of the sulphuric acid (H_2SO_4) is to take up hygroscopically the excess of water produced leaving the nitric acid (HNO_3) of which there is always an excess. The only known way of testing the quality of the pyroxyline is the use of the microscope in conjunction with the polariscope. A small piece of pyroxyline is taken from one of the jars, thoroughly washed in water and dried, it is then moistened with alcohol, when the colours exhibited should be in exact proportion which practice has proved to give the best results.

The pyroxyline is now taken out of the pots and subjected to pressure to extract all the acid possible. This extracted acid is not wasted, but is renovated with a mixture of new acid and used again for more cotton. From the press the pyroxyline is taken to the washing-room and at once put into the washing machine, called a Hollander, and similar to those used in paper-making for washing pulp.

This washing continues for from 12 to 15 hours until the acid is thoroughly eliminated; from thence the material is removed to a centrifugal machine to extract the moisture, which must not exceed 28 per cent.; if too much water is present the collodion will not be tenacious and therefore will not spin. The pyroxyline is now ready for dissolving in a mixture of alcohol and ether. The pyroxyline is placed in a cylinder, with a mixture of 40 parts alcohol and 60 parts ether; the cylinder is then hermetically sealed and made to revolve slowly for 12 hours, when, if the pyroxyline is good, all should be dissolved; the resulting mixture is collodion. The next process is the filtration. Upon this depends the amount of production from the spinning machinery supposing the collodion be good. The filtering is to eliminate every particle of suspended matter which may exist in the collodion before it arrives at the spinning

machines as grit and seeds from the cotton, or suspended matter in the washing water, or even trinitro-cellulose, which is insoluble in alcohol and ether, but this latter should never occur in good silk collodion. Each filter contains a sheet of cotton wool between calico. A pressure of 15 atmospheres is required to force the collodion through the filters; it is therefore first passed into an hydraulic press, by the aid of which it is forced through the filters and into the collodion reservoir, where it should remain as long as possible to allow any bubbles to rise to the top, for should they pass into the glass silkworms, the continuity of the thread would be broken.

A pressure of 40 to 45 atmospheres is required to force the collodion from these reservoirs to the spinning machines, which are constructed with pipes running on each side. Into these pipes are screwed a number of taps with a glass capillary tube fixed on the end, called a silk-worm, through which the collodion is forced by the pressure before mentioned; immediately it comes into contact with the air it solidifies, enabling the operative to take hold of the thread or silk, as it can now be called, and convey it to the bobbin. From twelve to twenty-four of these threads are run together on to one bobbin, according to the size of silk required, as is the case with natural silk. The silk would soon dry by the evaporation of the alcohol and ether if left exposed to the air; it is therefore kept moist by damp cloths to facilitate the next process of throwing and twisting. This is accompanied by putting on the silk the required number of turns or twists per inch. The reeling or skeining of the silk into a given number of yards in each skein is the next operation. One thousand or two thousand yards is the usual quantity, and according to the weight of skein so is the size designated. The Chardonnet silk is about 30 per cent. heavier in S.G. than natural silk, so the comparison of sizes is easily arrived at. The silk is still damp, and should now have the remaining alcohol and ether dried out of it. The inventor claims this to be one of the most important points to give the silk good dyeing properties.

The silk at this point of manufacture is very inflammable and quite unfit for use in textile goods, therefore a process called *denitration* is next carried out which reconverts our product into cellulose, now very different in appearance from the raw cotton we commenced with, but practically the same in chemical composition.

One of the substances used for this purpose is sulphydrate of calcium, and the chemical reaction may be expressed by the following formulæ:—

$$C_6H_8(NO_2)_2O_5 + 2\,Ca\,H_2S_2 =$$
$$C_6H_{10}O_5 + 2\,Ca\,NO_2 + H_2S + S_2.$$

The silk, now it is finished, requires no precautions in manufacturing more than cotton, in fact less, as there should be no loose fibre which can detach itself from the thread.

The bleaching is carried out in the usual way for vegetable fibres with chloride of lime and acid.

Up to the present time artificial silk has always been used in conjunction with other fibres in textile goods; the friction of weaving has a tendency to split the threads if used in warps, but this objection will no doubt be overcome.

Mantles for the incandescent gas light are manufactured of artificial silk, it being found that the salts of the rare metals can be mixed with the collodion with greater economy than with any other thread.

For braids and such classes of trimmings it is much more brilliant; for covering electric wires and all electric work it is better. Large works are in operation at Besançon, in France, producing 7,000 lbs. weight per week; but the demand is so great that they are making extensions to their works to enable them next January to produce 2,000 lbs. per day. The production at Sprietenbach is 600 lbs. daily. Other factories are about to be established in Belgium and Germany.

Collodion silk can never replace natural silk in articles where warmth is required, its composition being vegetable, and that of silk analogous to horn and hair or wool. The artificial product is to be preferred, being more durable than the natural when the latter is weighted in the dyeing up to 100 per cent. in colours, and as high as 300 per cent. in black. If this system of weighting natural silk for manufacturing dress goods continues, I am of opinion ladies will be asking for dresses of the new product in preference to the old, unless a guarantee is given that the article is pure natural silk.

DISCUSSION.

The CHAIRMAN said he found himself, as President of the Silk Association, in rather an anomalous position, in presiding at a lecture on the imitation of the product of the silkworm. Not many years ago he had the honour of reading a paper there on the Wild

Silk of India, which at that time was scarcely known, and in 1878, when he was asked by the Prince of Wales to show some specimens of the dyeing of tussore silk in the Indian Section of the Paris Exposition, he was informed by the people of Lyons that they were not using any of it, but they thought there would be an opening for it without interfering with the ordinary silk industry. Since then, he was glad to say, the French had been using it more and more, and last week, in the Lyons conditioning house, there were conditioned 224 bales, or about 29,000 lbs. of this wild silk. This had been done without in any way interfering with the old industry founded on the product of the *bombyx mori*, and it would probably be the same with this new product. Wherever original thought was brought to bear there was sure to be some useful result produced, and he had no doubt there was a future for this product. It was the result of very considerable chemical investigation which had been going on for many years. At the Paris Exhibition of 1878 he had the pleasure of meeting Count Chardonnet, who was then showing his new-born baby, which he called *soie artificielle*; he had persevered, and at length had succeeded in producing an excellent fibre. They had had Mercer's invention for brightening cotton, the late Mr. Miller's for making a lustrous fibre out of glue, Chardonnet's, and lastly, there was the process by which the fibre of silk itself was so enormously weighted, which was largely practised on the Continent. He was in Germany recently and brought back with him a sample of very thick brocatelle, in which 12 ozs. of the boiled-off silk forming the weft was weighted to 48 ozs. and of the warp to 40 ozs. This enabled the silk to be sold wholesale at about 2s. a yard, whereas pure silk of the same substance could not be produced for less than 8s. or 10s. a yard. This was effected chiefly by means of the salts of iron and tin and tannic acid. Notwithstanding all this, there never was a greater demand for silk than there was now; its value had been rising for some months, and threatened to rise still further—in fact, the demand was greater than the supply, so that he did not think the silkworm need fear any competition. Mr. Saatweber, one of the largest trimming manufacturers in Europe, told him that this fibre supplied a want: it had a lustre greater even than that of silk, and for trimming purposes it had a great future before it. The demand for his own factory had risen to 4,000 kilogrammes a month, and he could not get a sufficient supply. In fact there was no fibre, whether that of the nettle, rhea, cotton, hemp, or cellulose could be named for which there was not a use. He did not think this would ever be strong enough for the warp of a textile fabric, but it could be used as weft on a silk, cotton, or woollen warp. Its chief merit lay in its superiority of lustre, which resembled that of spun glass. On the whole, therefore, notwithstanding he had been devoting his attention for so many years to the development of the silk industry proper in England, he did not think he was guilty of any inconsistency in presiding on that occasion.

Sir FREDERICK BRAMWELL, Bart., F.R.S., asked if these artificial threads were produced of the full dimensions required for weaving or of a smaller size, several being spun together, as in the case of silk.

Mr. C. F. CROSS desired to protest against the term, "artificial silk," because artificial always suggested "spurious," and there was no need to apologise for cellulose, which could stand on its own merits. Some time ago he proposed the term "lustra-cellulose," and whether that were adopted or not he thought it would be a great pity if the present unfortunate name were retained. The Germans called it Glanz-cellulose. The history of artificial silk had been a very unfortunate one. He touched lightly on this subject in his Cantor lectures last year, and showed that many of the newer cellulose developments, more particularly, had been spoiled by a more or less irresponsible developments and inventions, misrepresenting actual values. As an instance, there was that Will-o'-the-wisp, rhea. That was a fibre which took people's fancy from its lustrous appearance, but the slightest microscopical examination by experts might have saved many thousands of pounds which were wasted over that matter. Ultimately it is finding its proper level and function, which was not that of a lustre fibre at all, but a fibre of exceptional length and strength, yielding very valuable products. "Artificial silk" was another captivating Will-o'-the-wisp, and its history also had a dramatic side, not unmixed with pathos. Many millions of francs had been thrown away, and many people had been almost ruined in developing an industry which to-day gave an output of a few thousand kilogrammes a week. He did not wish to belittle the pioneer work which had been done, but lustra-cellulose, prepared via collodion, was a very good result obtained by a very circuitous route. The empirical inventor sought a particular end. and would get it at any cost; and the artificial silk of to-day was one of the most wonderful and paradoxical triumphs of invention: a product, moreover, which cost 17 francs per kilogramme, and could be sold in any reasonable quantity at 50 francs, which was a very satisfactory result. But in order to produce this, cellulose had first to be tortured into a nitrate, then dissolved in highly expensive solvents, ether and alcohol, and the highly combustible nitrate had then to be denitrated. If Mr. Cash would look up the chemistry and literature of the subject he would find that there were other ways of getting cellulose into a plastic condition, which involved but a very small fraction of the cost of the process described. This was rather a specialists' question upon which he was now engaged, but he hoped

in the course of a few months that his criticisms would be more openly justified. The product now shown was technically beyond criticism, and if they could go on making it for 17 francs, and selling it for 50 francs, there would be a great future for the industry; but how would the matter stand if the price were reduced to 26 francs? Collodion silks *might* survive with that margin, but the probability was that the normal celluloses would be produced by the alkali methods at a cost of a few shillings per pound, which would ultimately compete with this product, and with textiles generally. That would be an interesting development when it came; meanwhile this artificial silk—so-called—had undoubtedly led the way, and he congratulated Mr. Cash on the work he had done in England in connection with it. He had no doubt had many difficulties to contend with, and he heartily wished him success. He should like to know if he could give the breaking strain of these threads in the same terms as the Chairman's well-known formula for natural silks, viz., in kilogrammes per square millimetre of cross section.

Mr. W. F. Reid said this was the last of the many new industries which had been introduced in that room. He had no doubt from the samples shown, and the interest aroused in textile circles, that whether this particular form of cellulose would hold the market, or whether some other form which might be produced more cheaply, of which they had not yet seen any commercial application, the production of cellulose which had been dissolved and subsequently drawn into a continuous thread through a nozzle, would become an enormous industry. There were several ways of producing cellulose in a form which could be ejected through a nozzle. Mr. Cross had referred to one which he held had proved very successful for many purposes, bnt others had been suggested. For instance, you might dissolve the celluloid direct by means of cupro-ammonium solutions. There were, however, two or three patents describing the use of such a solution by ejecting it into an acid—preferably acetic acid. The collodion process was a very circuitous and expensive way of producing a result which might possibly be attained by much simpler means. The first formula seemed rather long and intricate, but it might be simplified by cutting out the sulphuric acid, which played no part at all in the reaction. He had made many tons of nitro-cellulose without any sulphuric acid, and for some purposes it was better. Mr. Cash did not state the temperature at which the nitration took place.

Mr. Cash said he purposely omitted it.

Mr. Reid said there were so many conflicting data as to the temperature desirable in the preparation of soluble gun-cotton that it would be very useful if the temperature actually employed on a large scale could be given. It might interest Mr. Cash to know that spun glass was being made by machinery in Germany on a very large scale and could be obtained of almost any length of fibre—not perhaps quite so fine as the specimen shown—and it was used very largely for insulating electric wires, for currents of high tension, as it was very cheap. The Vandura silk was exceedingly interesting from the chemical point of view, and he did not think the remarks in the paper quite did it justice. It was not soluble in water and could be dyed after it was made. Mr. Cash had read an extract from a pamphlet, which was a reprint of an article in the "Journal of the Society of Chemical Industry," of January last, in which the author distinctly said it was not acted on by water, except that its tensile strength was sometimes diminished. It was dyed in the solution simply for convenience. He should like to ask why the denitrated cellulose was less inflammable than the cotton itself, as it seemed to be. He quite agreed with the objection which had been made to the name "artificial silk," but one could not go into a shop and ask for a lustro-cellulose necktie. Some short trade name was wanted, which would no doubt facilitate its use. Natural silk was so much adulterated that you could not get the pure article even if you wanted it and paid for it, and that opened the door for these artificial fibres; but the real test of their value would be the practical one. Chemical tests were useful in their way, but the final test would be how did the material wear? In conclusion, he thought it almost a pity that cotton alone was used in the manufacture, as there were many waste forms of cellulose which might answer the purpose equally well.

Mr. N. B. Wagle said he could not attempt to discuss the paper, as he knew very little of the subject, but a friend of his in India—Professor Gagar, a chemist of great eminence—was much interested in it, and he had seen the result of some of his experiments. The thread he had produced was stronger than that shown to-night, but it had not the same lustre. He should be glad if Mr. Cash would let him have some samples to send Professor Gagar, and he should be very pleased to put the two gentlemen into communication, and felt sure that if each would confide in the other, by joint action, much more progress would be made than if they worked separately.

The Chairman then proposed a vote of thanks to Mr. Cash, which was carried unanimously.

Mr. Cash, in reply, said the nitrocellulose was not highly explosive, as Mr. Cross seemed to imagine, or they could not manufacture it with safety; tri-nitro-cellulose would explode even if damp, but the bi-nitro-cellulose, which they used, would not explode if there was only 16 per cent. of water in it, and it was difficult to get it as dry as that; it was only when it was very dry that it would burn when a light was applied. The material was always called Chardonnet silk in France and Germany. He could not give the

breaking strain of the silk made at Coventry, as it was not so strong at present as it should be, and not so strong as that made at Besançon: when the process was more perfect in that respect the strength would be ascertained. The sulphuric acid was absolutely necessary in the production of bi-nitro-cellulose to take up the water. He did not wish to depreciate the Vaudura silk in the least, and he was aware of the statement in Mr. Millar's paper—that the formaldehyde made it waterproof; but he had not found it so actually. [He moistened one or two threads of this material, which immediately fractured.] Chemically, Mr. Millar was right, formaldehyde made gelatine insoluble, but the article produced certainly had not that quality. As to the denitrated cellulose being less inflammable than cotton, his idea was that the threads were closer together in the fibre, and therefore the air could not penetrate it so well. If it were chopped up into small lengths and then twisted together in the same way as cotton was spun, it would probably burn as freely. With regard to the suggestion that waste cellulose might be used instead of good cotton fibre for making the collodion, he could only say that the cellulose in different materials—rhea fibre, cotton, cabbages, and other things was different, and required a different strength of acid, different temperature—in fact, everything different. It was necessary, therefore, to adhere to one kind of cellulose which was fairly uniform and easy to obtain. The process must be exact to produce good results. Economy in working meant getting the largest result from the smallest amount of labour; if they got a fibre which would not work and spin freely, so that they could only spin 1 lb. where they ought to spin 50 lb. there was no economy, although the cellulose might be 2d. per pound cheaper. He should be pleased to give Mr. Wagle specimens to send to his friend in India, but he did not think he should be justified in giving him an exact description of the process employed. With regard to Sir Frederick Bramwell's question, he had stated in the paper that from 12 to 24 fibres were spun into one thread, just the same as with natural silk.

Miscellaneous.

TIMOTHY HACKWORTH, A NEGLECTED INVENTOR.

By Thomas Greener.

[Mr. Greener has prepared the following short account of Timothy Hackworth's inventions in the hope of drawing attention to the labours of one who he considers never got his due deserts in his lifetime. There can be but very few now living who can remember him, or who are in a position to write from personal recollection on the early history of the locomotive. Special interest therefore attaches to Mr. Greener's remarks, based as they are on personal knowledge.]

Timothy Hackworth was born at Wylam, December 22, 1786, the son of the foreman of smiths at Wylam Colliery. Timothy was apprenticed as a smith at this colliery, and on the completion of his apprenticeship he was raised to the rank of foreman smith.

In 1811 Wylam Colliery was the scene of his first prominent action in the improvement of steam locomotive power, by testing the efficacy of the smooth wheel on the smooth rail, which he did, under the auspices of the colliery owners, and in conjunction with Jonathan Foster, Mr. Hedley (colliery viewer), and his brother, Thomas Hackworth. Those gentlemen worked with him, but, as was well known, it was by Timothy's brain and skill that this essential point was practically settled. Trevithick's attempt in 1803 was a failure. J. W. Hackworth says, in his book, "Trevithick's Penydarran locomotive made one run only, with ten tons of iron from the works down the nine miles declivity to the Dock Basin, and was hauled back by horses. I have been on the course, and have handled the rails it ran over."

George Stephenson's Killingworth locomotive engine, built in 1814, had the smooth wheel and rail as used by Hackworth's locomotive, then recently built. It was notorious that about this period Stephenson made a practice, on Sundays, of seeing what was going on at Wylam.

The steam-blast for locomotives, as invented by Timothy Hackworth, is the life-breath of the high-pressure steam locomotive. It was used first in his engine, the "Royal George," built in 1827, and is continued to be used to this day in every effective locomotive. Mr. Nicholas Wood said, in his "Treatise on Railways," that G. Stephenson "got a steam-blast by turning the 'exhaust' from the cylinders through *two* pipes carried into the sides of the open chimney." Mr. Smiles copied this into his "Life of George Stephenson." He told me himself, when I saw him in Darlington on the occasion of the jubilee of the Stockton and Darlington Railway, that this was his only authority for saying in his "Life" that Stephenson was the inventor of "the locomotive steam-blast." I told him that I knew exactly what Hackworth's invention was, and that Nicholas Wood never dreamt of such a use being made of his passing remark, as he afterwards got to know that the essence of Hackworth's invention was to concentrate the two exhausts in *one* conical pipe, with a greatly reduced orifice, taking care that it was pointing up exactly in *the centre* of the chimney; and so this blast of steam had force enough to remove the pressure of air (15 lbs. on the square inch) from the top of the chimney. Thus by a natural law, and a simple contrivance, he obtained the draft necessary to keep up steam while the engine is travelling at any speed, any distance, in any weather.

The first four locomotives, used on the Stockton

and Darlington Railway in 1825-26, built by Stephenson, had Smiles's steam blast at work. On a calm day and level road they might go, for a short distance, at the rate of eight miles an hour. The working average was four miles an hour. Moving against a strong wind there came a stand still, causing "Jemmie" Stephenson (driver of the famous No. 1) to swear at "her" because she would not go, and was in the way of the men with horses hauling waggons. In 1828, Stephenson was not satisfied with this so-called blast, for he says in a letter to Hackworth, dated July 25, 1828 (a photograph copy of which I possess), "We have tried the new locomotive engine at Bolton; we have also tried the blast to it for burning coke, and I believe it will answer. There are two bellows worked by eccentrics underneath the tender." The bellows did not answer. Hackworth's invention was used in the "Royal George" ten months previous to the date of that letter, therefore, George Stephenson could not be the inventor of the *real* steam blast, as then and ever since used. This letter was shown to Mr. Smiles, and I concluded that, from my explanation, and the letter in evidence, I had convinced him of the error his book was spreading. I then suggested that he should, in the next edition, insert a note that he now had satisfactory evidence that Timothy Hackworth was the inventor of the steam blast as now used, and not George Stephenson, as he had stated. This error, however, has not been corrected, and it continues to be copied, recopied, and spread abroad, while Timothy Hackworth, the inventor of such a vital part of the locomotive, continues to be neglected, and his name known to very few.

The third primary essential for perfecting the locomotive did not escape Hackworth's notice, viz., the need of a multitubular boiler. He advanced as far as the return flue, giving double heating surface, used in the "Royal George" in 1827 and in the "Sanspareil" in 1829, also in other engines he built. It was Mr. Henry Booth, the talented secretary of the Liverpool and Manchester Railway, who completed the idea, and in 1829 he first got his invention of the small tube flues fixed in the "Rocket" at Rainhill. This invention has since proved to be one of the mainstays of the modern locomotive.

After having touched upon the three essentials of the locomotive, viz., (1) the smooth wheel on the smooth rail; (2) the steam blast; and (3) the multitubular boiler, I refer my readers, for details, to a small book entitled, "A Chapter in the History of Railway Locomotion, and Memoir of Timothy Hackworth (the father of locomotives) with an appendix by J. W. Hackworth." This may be seen at the British Museum, also at any of the free libraries. In that work will be found a correct history of other inventions by Timothy Hackworth, too numerous to be dealt with here, also true details of the strange story of the competition at Rainhill in 1829.

The battle of the steam locomotives for railways was fought and won at Shildon by Hackworth's "Royal George" and not by Stephenson's "Rocket" at Rainhill. Letters between Timothy Hackworth and Robert Stephenson clearly prove this. The opening of the second public railway, the Liverpool and Manchester, made the locomotive more widely known as a success, but nothing essentially new was brought out.

The "Sanspareil No. 2" was the last locomotive Mr. Hackworth designed and built. It was completed in 1849, and was a six-wheel express passenger engine. This engine, the particulars of which were published in the "Practical Mechanics' Journal," with illustrations, in 1849-50, has been a practical specimen for all engine builders, and its leading features may be recognised in every locomotive-producing country; and although the weight of modern locomotives has been increased, the principle remains the same. In the experimental trials on the London and North-Western, the Midland and North-Eastern Railways, this engine attained a speed of eighty miles an hour. The executors sold it to the North-Eastern Railway Company. After working seven years on their line a very windy month occurred, at which time one of the officials stated that she was the only engine that could keep time with the express train.

It has been truly said, "Timothy Hackworth avoided popularity, which had no fascination for him; he loved retirement, and preferred the joys of private life, though a public character, not to be so universally known." By his workmen he was revered, respected, and loved.

These facts are not copied from writers of books who did not understand the subject, but from what I know from personal observation, and from those directly in touch with the workers in their early struggles to perfect this wonderful machine, the steam locomotive engine. Those who believe this record can devise means to make Timothy Hackworth's name and work more widely known, say, by contradicting false assertions, by voice and pen, &c., and thus to let honour be given to whom honour is due. This may be done without detracting one jot from George Stephenson's deserved fame, who, although not a mechanic and by no means an inventor, was great in surveying and making railroads, while Timothy Hackworth raised the locomotive from the abject condition in which he found it, not able to do as much work as horses, its average running being 4 miles an hour in 1825-6, while the "Royal George" in 1827 came up to 20 miles an hour, and his "Sanspariel No. 2" 80 miles an hour over the railroads that his old friend Stephenson was so truly famed for making.

To erect a monument on some suitable spot, or to ask the authorities to allow a tablet to be placed in Westminster Abbey to the memory of Timothy Hackworth, would be a just and gracious tribute to this hitherto neglected inventor of the nineteenth century.

STERILISATION OF WATER BY OZONE.

Since 1891, the sterilisation of water by means of ozone has been the subject of numerous investigations. M. J. Blondin, in an article in *Eclairage Electrique*, refers to some of the earlier of these, and then passes on to a description of the apparatus designed by Marmier and Abraham, and of the results obtained by them at Lille in 1898-99. The installation comprises an alternating current generator, a transformer giving 30,000 volts at the terminals of the secondary, a plate ozoniser, and an absorbing tower. The special form of ozoniser used has each of the metallic electrodes enclosed between two glass plates. The electrodes are kept cool by means of water. The absorbing tower is built of masonry.

Tables are given showing the chemical and bacterial character of the water before and after treatment with ozone. The ozonised air passed into the absorbing tower contained between 5·8 m. grs. and 9·5 m. grs. ozone per litre. The organic matter was reduced from ·014 grm. per litre to ·003 grm. per litre, and the bacteria in several instances were completely destroyed, while in other cases they were greatly reduced in number and activity. It was noticed that the results were best when the bacterial examination of the water did not immediately follow the treatment in the ozonising tower.

The report of the Commission appointed by the Municipal Council of Lille to examine the apparatus and process is given as a note to the article. This report is favourable to the method, and recommends the adoption of the Marmier and Abraham sterilising process at Lille, where the present water supply is contaminated, and typhoid fever is prevalent.

The author, in conclusion, discusses the question of cost, and expresses his regret that Marmier and Abraham have not supplied the necessary data to enable this to be accurately fixed.

Science Abstracts, from which the above is taken, also refers to Mr. Andreoli's paper on the same subject in the *Electrical Review*. After criticising the form of ozoniser used by Marmier and Abraham, he quotes several passages of this report, in which the efficiency of ozone as a germicide is proved.

The author next discusses the question of cost, and states his opinion that the 2 centimes per cubic metre, given by Marmier in an earlier paper, is too high. In order to throw further light upon this question, Andreoli has himself recently carried out experiments in London, and has measured the consumption of ozone in terms of electrical energy. The experimental plant consisted of a small Andreoli ozoniser worked at a tension of 3,500 volts, a Roots blower for forcing the ozonised air through the water, and five tanks in which the absorption of ozone by the water occurred. The plant permitted the treatment of 440 gallons water per hour. A Table is given showing the effects obtained, with expenditures of electrical energy, varying from 138 to 316 watts per cubic metre (220 gallons) of water.

The author concludes from his experiments upon Thames water that complete sterilisation of water drawn from the river at specially selected spots could be obtained with an expenditure of electrical energy equal to 100 watt-hours per cubic metre of water.

M. Blondin, in his paper, refers to Andreoli's claim to have designed an ozoniser giving more economical results than the form used at Lille, but points out that in the absence of more complete data it is impossible to compare the results obtained by the two forms of ozoniser and systems of treatment.

CURRENCY OF THE PHILIPPINE ISLANDS.

The following report on the history and condition of the currency of the Philippine Islands is from the British Vice-Consul at Manila to the Secretary of State for Foreign Affairs:—

Gold.—The currency of the Philippine Islands was originally gold, Spanish "onzas" of Charles III. and Ferdinand VII. predominating. Small gold coins, with "Filipinas" inscribed on them, of 1 dol., 2 dol., and 4 dol., were locally minted at Manila, and were not current in Spain. The Manila mint was opened to the public until 1868 for the coining of the above three pieces at a small charge. Coined gold (principally 20 dol. American eagles) was recoined. Very few ingots, if any, were used for this purpose, the operation leaving a clear profit of 18 to 20 per cent. This practice ceased when exchange declined heavily and left no profit.

Silver.—Mexican and old Spanish dollars, with fractions of the latter, constituted the silver currency. These Spanish coins, which comprised the now rare "Dos Mundos" set and specimens of Ysabel II., together with the imported Mexicans, were frequently at a premium over the gold dollar, similar conditions also existing in the Island of Cuba. When, however, silver began to depreciate, the gold coin was rapidly exported and replaced by Mexican dollars. In 1877 the gold currency was considered a failure owing to the above reasons. About this time a law was passed by the Spanish Government prohibiting the importation of Mexican dollars, but permitting the circulation of those that were already in the islands. Smuggling from China of Mexican dollars (dated previous to 1878) was carried out during the Spanish regime, in many instances with the aid and knowledge of the Spanish Customs and other officials. Gold consequently left the islands completely. The dollars fluctuated according to the price of silver, as the fluctuation reached sometimes 10 to 15 per cent.; the smuggled importation continued until it would drop to "par." For instance, during the export season when money was scarce, Manila rates would rule as high as 10 to 15 per cent. over those in Hong Kong and China, whence the dollars were smuggled,

which attracted contraband, while in the autumn the exchange would fall to "par" on those places, there being frequently an export of Mexicans at this season, to be again replaced by smuggled coins when required.

The Government at Madrid, it is said, endeavoured to alleviate this state of affairs, especially as there was a big depreciation of Philippine as compared with Spanish silver, but could not act for the want of funds. Several millions of Mexican dollars were recoined in Manila and converted into pieces of 10, 20, and 50 cents—835 fineness and 25 grammes; the Treasury gained 10 per cent. on this operation, but was unable to materially decrease the large stock of Mexicans. These locally minted pieces differed from the Spanish inasmuch as the value was stated in the fractions of a "pesu," thus the 20 cent. piece was inscribed "20 cent. de pesu," while of those in Spain the value inscription read "una peseta."

In 1897 the monetary question became serious, and at the commencement of the Philippine insurrection some six millions of coins of 1 dollar each, 900 fine, 45 grammes, were minted in Spain and sent to the Philippines. They were similar to the Spanish current dollars, but were marked "Islas Filipinas," and bore the head of Alfonso XIII. These dollars were 8 per cent. under the value of the Mexicans. Some seven or eight millions may be considered as a fair estimate of the number of Mexicans circulating in the Philippines at this period. Besides this, in 1896, a large quantity of half dollars was exported for use in Morocco—presumably to pay part of that country's indemnity to Spain, until legislation put an end to the business.

On arrival of the Americans a large amount of United States gold was bought by the military. Some difficulty was experienced at the beginning, as the natives and Chinamen did not know the values. The exchange of United States gold or silver to Philippine or Mexican silver is commonly accepted at 1 dol. United States to 2 dols. Mexican or Philippine; but the exchange varies at the banks and large commercial houses according to the value of the Mexican dollar in London and San Francisco. Mexican dollars, irrespective of dates, have been recently imported through the banks in large quantities. There is a shortage of subsidiary coinage, no fraction of the Mexican silver dollar having ever been in circulation.

Notes.—Notes of 5 dols., 10 dols., 25 dols., 50 dols., and 100 dols, and it is believed some few of 200 dols., were issued by the Banco Espanol Filipino, and are still current. The notes of 200 dols. are now being recalled. This question of notes is problematieal. The American authorities may recognise the privileges granted by the Spanish Government to this bank, 21 years of which are still unexpired.

Copper.—In the reigns of the later Philips and Ferdinands, special coins of two, one, and a half cuartos were minted, probably in Spain, for the use in the "Ultramares" (principally in the Philippines). They are now extremely rare, and are not found in circulation. The copper coins which were current in Spain and issued by Charles III., Philip V., Ferdinands VI. and VII., and Ysabel II., were imported into the Islands. They consisted of the following values: 2 cuartos, 1 cuarto, ½ cuarto or "octavo," and the "maravedi" (¼ cuarto).

The three latter denominations were little used, the Chinese retail vendors ("Sari-Sari") giving a counter or token, locally called "picha," of turned wood with a bone centre, bearing a Chinese inscription, which was accepted in lieu of a cuarto. In Spain the "peso," or dollar, was divided into 20 "reales" of 8 cuartos each, while in the Philippines 8 "reales" of 20 cuartos composed the dollar. The pieces of "two cuartos," on account of their circulation, both in Spain, and after in the Philippines, became almost illegible, and in some cases appeared to be only round pieces of copper. Most of these coins have now been exported to Spain or China to be used as old copper. A short time before the late war, 5 lacs of dollars in copper coins (two values, 1 cent. and ½ cent. of a peso) similar to the ones now current in Spain, belonging to the Provisional Government and Alfonso XII., were imported. Most of this shipment has gone inland, a small amount remaining in the Treasury. Small quantities have also found their way back to Spain, as these coins are still current there, they afford the only means of taking money to the Peninsula without losing on the exchange. Some United States bronze cents, valued at 2 cents local, are to be seen. Owing to the lack of copper coinage, cents from Hong Kong, Straits Settlements, and adjoining British possessions are also to be met with.

CHINA SILK TRADE.

It is worth while to remember that, however hopeful European exporters may be of finding in China increasing outlets for their goods, the fundamental condition for a brisk import trade is an increasing export trade, and that lately some very alarming statements have been made respecting one of the most important of China's industries, the production and reeling of silk. The alleged decadence of this industry appears the more serious as similar reports have for some time past been current with regard to another leading Chinese industry, that of tea cultivation and preparation. Mr. Rocher, the Commissioner of Customs for Shanghai, made some statements in his report on the trade of that port during last year, in which he called attention to the inferiority of last year's cocoons in China, the spread of disease amongst the worms, and the general lowering of the vitality of the breeds. Mr. Rocher has followed up this warning by a letter to the Viceroy—which has been published in the

Chinese *Gazette*—in which he makes some very emphatic statements respecting the extent and reality of the evil. Nine years ago, when the question of Chinese silk culture was taken up by a predecessor of Mr. Rocher, many of the silk growing districts were still free from disease, but in consequence of the neglect of the warning then given the disease has since made "enormous progress," and China seems to be threatened with that general extermination of the silkworm which had almost been completed in France and Italy when Pasteur began his memorable researches into its causes and succeeded in arresting its march and reconstituting the industry in both countries. It may now be said, Mr. Rocher urges, that almost all the silkworms in China are diseased, and the effect on the silk-producing capacity of the worm is very marked. Formerly one picul of silk was obtained from three piculs of cocoons, but last year five piculs of cocoons, on the average, only yielded one picul of silk, and this year six and a half piculs of cocoons have been consumed in obtaining the same result. Owing to bad and short crops, the cocoons have been dear as well as poor, and it is in consequence of this fact that so many of the steam filatures, or silk spinning mills, in the Shanghai district have been closed, the total number of these establishments at work having been reduced from 25 last year to 11 this year. It is now stated that not a single district in China where silk culture is carried on remains quite free from the disease. This condition of affairs implies a large loss of revenue for both the central and provincial Governments, and the Kiangsu and Chekiang provinces, hitherto made rich by the silk industry, are likely to be impoverished more and more every year if the ravages of the disease are not arrested.

Under these circumstances, Mr. Rocher, who two years ago made suggestions to the Viceroy for checking the decay of the tea trade of China, appears to have succeeded in awakening the Viceroy's interest in the silk question, and in obtaining official financial support for organised methods of re-establishing healthy breeds of silkworms throughout China. His plan consists in the adoptlon of the methods recommended by Pasteur—the selection of healthy moths by the aid of the microscope for the production of healthy eggs. Two "nurseries" are to be established in the provinces of Kiangsu and Chekiang respectively, each of these stations to be under the charge of a foreign assistant, and the two stations to be under the control of a foreign director. Mr. Rocher estimates that in three years' time a sufficient number of pupils will have been trained and native breeders educated to enable the growers to go on without further external assistance. Expensive buildings, he has pointed out, are not necessary for the experimental stations. The necessary expenditure, he estimates, will be fully provided for by a payment of 6,000 taels per annum during the three years by each of the two provinces mentioned. It is stated that provision has already been made by the Viceroy for the payment of these subventions, which, in comparison with the enormous importance of the work to be done, may well be regarded as extremely moderate. No little importance may also be attached to the educational influence of this latest attempt to introduce Western science into China. The proposed "nurseries" may prove not merely instrumental in regenerating the Chinese silk industry, but influential aids in the regeneration of the Chinese Empire itself. Hitherto, according to the *North China Herald*, the greatest obstacle in the way of all attempts to impress the Chinese silk growers with the suicidal nature of their past neglect has been the competition among the foreign buyers of cocoons. So long as the breeder can sell his cocoons at a good price he cares nothing about their quality, and as the weight of silk in the cocoons has decreased he has tried to keep up the qnantity by hatching more worms, with the result that the price of mulberry leaves has been raised, and a very large proportion of the worms are "half starved and sickly creatures, unable to produce either quantity or quality." The filatures have had to pay higher prices for the cocoons, and the outlay in wages per picul of silk obtained has also been increased, as more labour in proportion to the result is required for the manipulation of cocoons of inferior than for those of good quality. Another difficulty is apparently the unwillingness of the Chinese to pay for experiments with a view to a future reward. It is for this reason that Mr. Rocher has refrained from endeavours to obtain financial support for his undertaking from native merchants and silk growers. "The trade," he remarks in his letter to the Viceroy, "is sufficiently taxed already, and further taxation would increase the harm;" moreover, it would make those interested suspicious and "provoke their ill-will instead of their co-operation." It is by a demonstration of the practical benefits to be ultimately reaped that Mr. Rocher hopes to convert the native growers and merchants.—*The Textile Recorder*.

Obituary.

SIR HENRY TATE, BART.—Sir Henry Tate, the munificent founder of the Tate Gallery (National Gallery of British Art) at Millbank, died at his house, Park-hill, Streatham-common, on Tuesday, 5th inst. He was born at Liverpool, March 11th, 1819, and he carried on business in that city for many years, until, about 25 years ago, he transferred his great business of the manufacture of cube sugar to London. He gave £42,000 to the newly-founded University College, Liverpool, and a still larger sum to various Liverpool hospitals. He built the Brixton Free Library, but his great achievement was the foundation of the gallery at Millbank. He offered to build a gallery, at a cost of £80,000, as well as to present

his collection of paintings of the British school to the nation. It is said that he spent double that amount on the gallery. The building was completed on the very day that he took to his bed in his last illness. He was created a baronet in 1898, and he became a member of the Society of Arts in 1897.

General Notes.

Commercial Congress at Philadelphia.—The following resolutions have been passed at the Commercial Congress held at Philadelphia:—(1) Recommending all nations to join a union for the registration of trade marks; (2) recommending all Governments to establish a parcel post system; (3) in favour of uniform trade statistics for all nations; (4) requesting the nations to establish an international bureau for the collection and dissemination of agricultural reports; (5) recommending the Philadelphia Commercial Museum to the support of Governments and Chambers of Commerce; (6) recommending international arbitration as far as possible: (7) endorsing the speedy construction of an inter-oceanic canal.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings at 8 o'clock:—

December 13.—"Sea Angling and Legislation." By F. G. Aflalo. J. W. Willis Bund will preside.

December 20.—"Bi-Manual Training by Blackboard Drawing." By H. Bloomfield Bare, F.R.I.B.A. Walter Crane will preside.

Indian Section.

Thursday afternoons at 4.30 o'clock:—

December 14.—"Round about the Andamans and Nicobars." By Colonel R. C. Temple, C.I.E.

Cantor Lectures.

Monday evenings at 8 o'clock:—

Henry Hardinge Cunynghame, "Art Enamelling upon Metals." Four Lectures.

Lecture IV.—December 11.

The application of enamel to jewellery—Gold working—Gilding.

MEETINGS FOR THE ENSUING WEEK.

Monday, Dec. 11...SOCIETY OF ARTS, John-street Adelphi, W.C., 8 p.m. (Cantor lectures.) Mr Henry Hardinge Cunynghame, "Art Enamelling upon Metals." (Lecture IV.)

Mechanical Engineers, Storey's-gate, St. James's park, S.W., 7½ p.m. (Graduates' Meeting.) Mr W. B. Cleverly, "Works Management, Method of Quick Production of Repetition Work."

Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned discussion on Mr. Philip E. Pilditch's paper, "Party Walls under the London Building Act, 1894."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. M. Francis Bond, "Architecture and National Character."

Tuesday, Dec. 12...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. C. Newton Russell, "Combined Refuse-Destructors and Power-Plants."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Thomas Brown, (1) "Notes on the use of the Dallmeyer Focometer," (2) "The Origination of Printing Types by Photographic Methods."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Asiatic, 22, Albemarle-street, W. 4 p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

Wednesday, Dec. 13..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. F. G. Aflalo, "Sea Angling and Legislation."

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. Arthur Newsholme, "The Health of Scholars with special reference to the Education Code, and Board of Education Act, 1899."

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. Osman Edwards, "Japanese Theatres."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

Thursday, Dec. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Col. R. C. Temple, "Round about the Andamans and Nicobars."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Edward Step, "Some Wild Flowers and their Ways."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Messrs. Crompton's and John Holloway's papers. 2. Mr. F. Hope-Jones, "Electrical Time Service."

Historical, St. Martin's Town-hall, Charing-cross-road, 5 p.m.

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. B. Worsfold, "England in South Africa."

Mathematical, 22, Albemarle-street, W., 8 p.m.

Friday, Dec. 15...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Blamey Stevens, "Sludge."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Saturday, Dec. 16..Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

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FRIDAY, DECEMBER 15, 1899.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

Mr. Henry Hardinge Cunynghame delivered the fourth lecture of his course on "Art Enamelling upon Metals," on Monday evening, 11th inst.

On the motion of the Chairman (Sir Frederick Bramwell, Bart., D.C.L., F.R.S.), a vote of thanks to the lecturer was passed.

The lectures will be printed in the *Journal* during the Christmas recess.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, 1900, at 7 o'clock, by Herbert Jackson, on "The Phenomena of Phosphorescence."

The lectures will commence at 7 o'clock. Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions each member is entitled to a ticket admitting two children and an adult. Members requiring these tickets should apply at once.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by Members on application to the Secretary.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Thursday, November 23, 1899; Sir Thomas Sutherland, G.C.M.G., LL.D., M.P., in the chair.

The paper read was—

OLD AND NEW COLOMBO.

By John Ferguson.

Introductory.

The following paper was suggested by one on "Calcutta," read before this Society on 1st June last, by Sir Charles Cecil Stevens, K.C.S.I.; but on that occasion it was especially the Port and Trade of Calcutta, with reference to successive improvements in the navigation of the Hugli that was dealt with; while, in the case of Ceylon, my object is to present you with a rapid sketch of the founding of Colombo on the sea-coast, and of its history under the Sinhalese, the Portuguese and Dutch, and then to treat more in detail its rise under the British Government to be the commercial and political capital of the island, and, later still, its claim to be the great steamer calling and coaling port between Asia and Australasia, with one of the most convenient and commodious of artificial harbours in the world. Incidentally, I will endeavour, however poorly, to present you with a word-picture of one of the most beautiful and interesting of tropical cities, with its people—their social life, industries and trade—representative of nearly every Eastern land, and offering in the native bazaars an ever-varying scene of marvellous kaleidoscopic effect.

"Old Colombo"—with the history of the town from its foundation to its occupation by the British in 1796—might well form the subject of a paper in itself. But I must content myself with a very brief outline, and first of all would mention that the rocky headland, forming a small shallow harbour, was the *Jovis Extremum*, or Cape of Jupiter, of Ptolemy. According to old Sinhalese authorities *Kolamba* means a port of call for vessels, and there we have the origin of the name, and not in fanciful modern derivations, one of which actually connected this far Eastern port with the name of the great Genoese navigator and discoverer of America, Columbus. The first authentic notice of the

town seems to be by the Mohammedan traveller, Ibn Batuta, who visited the island about 1346. He writes:—"We started for the city of Kolambū, one of the finest and largest cities of the island of Serendib. It is the residence of the Wazir, Lord of the Sea, Jâlasti, who has with him about 500 Habshis (Abyssinians)." By an old Chinese writer the port is spoken of as Kao-lang-wu or Ko-ling-lo.

The Portuguese Era.

Strangely enough, in view of what we are told of the town as described in 1346, when the Portuguese arrived in 1505 or 1506 they seem to have found at Colombo no more than a few huts covered with cadjans or dry, plaited cocoa-nut leaves, the Sinhalese king at the time having his residence at Cotta, some miles inland. In occupying Colombo, with its natural advantages for the shelter, during a great part of the year, of the small vessels of those days, the Portuguese at first erected a few buildings for trading purposes, a store for cinnamon, a residence for their factor, &c.; and it was not till 1518 that they constructed a fort which, however, was dismantled, for some reason unknown, a few years later, and then the Portuguese made their headquarters at Cotta, the Sinhalese monarch having formed an alliance and come under their protection. This alliance was very displeasing to the majority of the native chiefs and people, and war broke out, forcing the Portuguese once more to fortify Colombo. One story told is that from the scarcity of lime, shiploads of shells of pearl oysters were transferred from Aripo, to be made into mortar for the fort walls. The warlike Sinhalese king—Raja Sinha, or Lion King—besieged Colombo in 1563-4, and fortifications must then have existed; but these were greatly extended later on, for the account of the long but ineffectual siege of 1585-7, by the same monarch, with 50,000 men and 2,000 elephants, shows that the walls (mounting upwards of 200 guns) extended as far as they did when the Dutch besieged the town 70 years later. Several churches, convents, and monasteries had been built, and there was a Chamber with aldermen, and names were given to various suburbs now included in the town. Building outside the fort commenced some years later, and by 1613, we are told by one writer that the houses were getting near to the Kelani river, the present northern boundary of the city. I will attempt no further description of Colombo in Portuguese times; but will allow you to gather some idea from the plans which will be shown you on the screen later on. But I may mention that the trade of Colombo, in the time of the Portuguese, scarcely repaid them for the expenditure required for its protection in the almost continuous wars with the Sinhalese and their allies, the Moormen—or Arab descendants—who bitterly resented the advent of Europeans to take away viâ the Cape of Good Hope, the trade they had so long controlled by way of the Red Sea and Persian Gulf, with overland caravans. Conquering and administering the maritime provinces, the Portuguese Captain-General of Colombo, took the title of King of Malwane, and strictly prohibited trade to every other nation, even to the Sinhalese. Royal monopolies were formed of cinnamon, pepper, and musk, while cardamoms, sugar, and ebony, areca-nuts, elephants, ivory, gems, pearls, and some silk, tree cotton and tobacco were included in the exports. Vessels came for these commodities from Persia, Arabia, Bengal, and China, as well as from Europe or the Cape.

The Dutch Era.

Meantime, towards the end of the 16th century the Dutch had formed a trading "company for distant lands," and soon after the first fleet started round the Cape for the East. On 30th May, 1602, the first Dutch ship seen in Ceylon anchored off Batticaloa on the east coast, and the admiral in command entered into an alliance with the Kandyan King and this had momentous consequences for the Portuguese, eventually leading to their expulsion from the island which their monarch had said he "would rather lose all India than imperil." The conflict between the two European powers for supremacy in Ceylon commenced in 1638, and culminated with the great siege of Colombo nineteen years later. Very elaborate accounts of this siege, lasting from October, 1655, till 12th May, 1656, are extant; but I must only mention that the Portuguese offered a most determined, strenuous defence, and although assisted by the Kandyan king with an army of 40,000 men, the Dutch lost their General, 3,000 men killed, besides the wounded, and were reduced to the last strait before victory was attained. Of the Portuguese and native soldiers in the Fort, numbering perhaps 1,500, only a small percentage survived to surrender. Upwards of 900 noble Portuguese families were, at the time of the siege, residing within the town, besides 1,500 families of those connected with the Courts of Justice, merchants and traders—

some of these left with the remnant of the garrison for India; many settled in Kandyan territory, especially at Ruanwella under the auspices of the Sinhalese king, while the rest are represented by mixed descendants who use a *patois* of Portuguese in Colombo to the present day.

Refusing to give up their conquests, the Dutch found themselves in turn attacked by the native king, whom, however, they defeated and very soon became masters of the seaports and lowlands of Ceylon, doing their very utmost to develop trade and avoid war. Among other improvements due to the Dutch and which benefited Colombo, was the system of canals to the north and south of the capital; while cultivation in cinnamon, pepper, coffee, and cocoa-nuts was encouraged. A new fort was built at the capital after a substantial and scientific plan by Cohorn, and the Dutch were determined to retain what they deemed the gem of their Eastern possessions. Just as the Portuguese burnt all the cinnamon for which there was no sale at the end of each season, the Dutch made it a crime punishable by death for any native to harvest bark or cut down a cinnamon bush even in his own garden, so strict was their monopoly, and they esteemed the cinnamon growing between Colombo and Negombo as the best in the world; while they encouraged trade from the Government stores — no private trading being allowed—with all parts of the East as well as Holland. If time and space permitted, an interesting picture might be sketched of the settlement and life of the Hollanders — the officials and citizens or burghers—in Colombo for the last 100 years of their occupation; of their public spirit in respect of canals and in founding churches and some schools; but also of their harsh treatment of the natives, thousands of whom they kept as slaves, and of their selfishness and extortion in respect of trade. Notwithstanding the great value which they attached to their possessions, it is amusing to read in the account of a Belgian physician, who resided 18 months in Ceylon in 1687-89, that in his estimation the whole island (save for its cinnamon) was not worth as much as an ordinary village in Brabant or Flanders; the fruits not worth describing; the cattle so thin as scarcely to be eatable; while the harvest of fish for a year was not worth as much as the fish that came into the market of Antwerp on a single Friday. The Kelani River, north of Colombo, he regarded as about half as broad as the Scheldt at Antwerp. He described Colombo as divided between an old town and a new one or castle or fort. The old town was an oblong quadrangle 1,000 by 700 spaces, divided by three streets both ways, so the city was made up of 12 squares or cubes. But I must content myself with showing you, later on, plans of Colombo in the times of the Dutch, by the help of the lantern.

Colombo in 1796.

On 16th February, 1796, the Dutch Governor surrendered Colombo to the British, who took possession in the name of William of Orange, Holland being at that time in the hands of the French.

In "Walsh's Military Reminiscences" there is a description worth quoting of the town at the time of its capitulation to the British:—

"Columbo, the capital of the Dutch in Ceylon, is a place of considerable consequence and strength from its natural position, as well as from its works, which were numerous and in good condition. The fort, which is extensive, contained many capital dwelling-houses, including the Governor's palace, which is a most superb building. The Pettah had also several good houses, churches, &c., in it; and in the place, altogether, were many respectable inhabitants. Without a chance of relief it would have been madness to have held out; and by an early capitulation private property was preserved. Columbo is also a place of great traffic by sea, the roadstead being extremely safe and commodious, particularly during the north-eastern monsoons."

On the surrender of Colombo, many of the principal Dutch inhabitants left for Batavia; but the clergy, judicial officers, and the bulk of subordinates employed in the different departments continued at their posts; and their descendants are found in Colombo to this day in the majority of our lawyers, physicians and teachers, and of the Government clerks, a most worthy body of public servants. The dominion of the Dutch had lasted about the same time as that of the Portuguese, namely, 140 years: the latter left their mark in the very considerable number of Roman Catholics among the natives, to whom high-sounding names were given in baptism; while the chief inheritance from Holland was the code of Roman Dutch law.

Early British Rule.

For some years the change to British rule made little difference to Colombo; indeed, up to 1815, when the Kandyan kingdom was formally annexed, the island was expected to be given

back to Holland; but in that year it was finally decided to retain Ceylon and to give the much larger and richer Java in exchange to the Dutch. With the advent of Sir Edward Barnes as Governor in 1824 a new era of activity began, through the opening of the island by military roads, the construction of a bridge of boats over the Kelani River and the starting of the first mail coach in Asia between Colombo and Kandy. Sir Edward also built, at a cost of £30,000, a palatial residence for himself at Mount Lavinia, on an eminence jutting into the sea, seven miles from Colombo, and here and in the neighbourhood some strange episodes occurred in those early days when Ceylon was a mere military dependency. On one occasion, in the adjacent cinnamon gardens, the Chief Justice and Major-General commanding in the island exchanged pistol shots in a duel about a trifling difference of opinion; and many other stirring experiences are related in the autobiography of the late Major Skinner, the great road-maker of Ceylon, who served the colony in the most admirable way for over 40 years. In the time of Governor Sir Robert Wilmot Horton, 1832-37, Moormen and Tamils were allowed for the first time to own house property in the Pettah and Fort of Colombo, a privilege which the Dutch would never grant. The first Savings' Bank, Royal Academy or College, and the Legislative Council with unofficial members date from the same time, as also the establishment of the Press and of the Indian rupee currency. Steps were taken by Governor Stewart Mackenzie for the complete abolition of slavery, and this was finally consummated in 1845; although the name of "Slave Island" still adheres to the peninsular division of Colombo in the midst of the lake, because there the Dutch kept their slaves—an arrangement due to the fact that one night the slaves of a certain Dutch household in the Fort rose and murdered the whole family. After that, all the slaves in the Fort, after the day's work was done, were collected in punts and rowed out into what was nearly an island and there kept under guard until the time came to return and engage in their daily toil. A description of Colombo in the Thirties comes to us in verse from the pen of a military officer, Captain Anderson, who wrote "Wanderings in Ceylon":—

"Hence, let the eye a circuit take,
Where gently sloping to the lake,
A smiling, lively scene appears,
A verdant isle, its bosom rears,
With many a lovely villa grac'd,
Amid embow'ring cocos plac'd!
Here once, to all but int'rest blind,
The Colonists their slaves confin'd;
But now the name alone remains.
Gone are the scourges, racks, and chains!
When Britain sought the eastern world,
And her victorious flag unfurl'd,
She came to heal, and not to bruise,
The captive's fetters to unloose;
And 'tis her brightest boast and fame,
That nought is left beyond the name
Yet here the African remains,
Though broken are his slavish chains,
Prepar'd to conquer or to die
For her who made his fetters fly.
As soldier of a free-born state,
He feels his dignity and weight;
And with alacrity and zeal,
The sable warrior learns to wheel.
But view him at the set of sun,
His military duties done,
His native glee will then be seen
In antic frolics on the green;
See him with sparkling eyes advance
To tread his own Mandingo dance,
And view his smiling jetty bride,
In cadence moving by his side;
Then own no joys the soul can move,
Like those of liberty and love!"

The "Africans" referred to were Kaffirs imported to work as pioneers on the roads, which the Sinhalese were too lazy to do, after the *rajakariyà*, or forced labour, imposed on them by their own rulers, and by the two preceding European Powers, was abolished under the more civilised and benign administration of the British. Kaffir descendants are still to be noted among the many races and nationalities—some 70 in all—comprised in the population of Colombo.

I have said that the colony was a mere military dependency for many years: five or six infantry regiments, with artillery, Royal Engineers, and even a troop of cavalry being maintained at the expense of the Imperial Government up to the Forties—so that Colombo, as the head-quarters of a Lieut.-General and Staff and of most of the troops, was a lively place from a military point of view. When such regiments as the 90th (Perthshire) Light Infantry, with its band playing reminiscences of "The Lass o' Gowrie"—

"'Twas on a simmer's afternoon,
A wee before the sun gaed doon
My lassie wi' her braw new gown
Cam' o'er the hills to Gowrie"—

were paraded with the 18th Royal Irish, its music reiterating this inquiry—

"Oh, say were you ever at Donnybrook Fair?
An Irishman all in his glory was there,
With his sprig of shillelagh and shamrock so green!"—

and the 95th, or Ceylon Rifles, band giving "British Grenadiers,"—Colombo had a large and lively garrison. But from a commercial

and trading point of view the town was then very insignificant. We date the practical beginning of the coffee planting enterprise in Ceylon from 1837, although Governor Barnes and Geo. Bird had started plantations 13 years earlier; and I have often heard my relative and predecessor in the *Ceylon Observer*—the late A. M. Ferguson—say how depressing was the sight of Colombo roadstead when he entered it with Governor Stewart Mackenzie in November, 1837, with only one or two of Messrs. Tindall's barques of 400 to 500 tons representing the tonnage for imports from and exports to Europe, the wharves silent and almost lifeless, and a general appearance of do-nothingness about the place. The planting industry wrought a wondrous change, for in 40 years the coffee exports rose from 30,000 to 1,000,000 cwts. per annum, and steamers as well as sailing ships were required to carry the trade even before the opening of the Suez Canal introduced so complete a revolution in our Eastern shipping experience. I may mention here that the export of tea has now attained a heavier net weight, in 125 million pounds, than ever coffee reached; while Ceylon products exported, which represented a shipping tonnage of 120,431 in 1888, had risen by 1897 to 245,830 tons, and must altogether require a freight of about 280,000 tons. Of this, tea makes up about 46 per cent. and the produce of the cocoa-nut palm about 41 per cent.

Colombo Forty Years Ago.

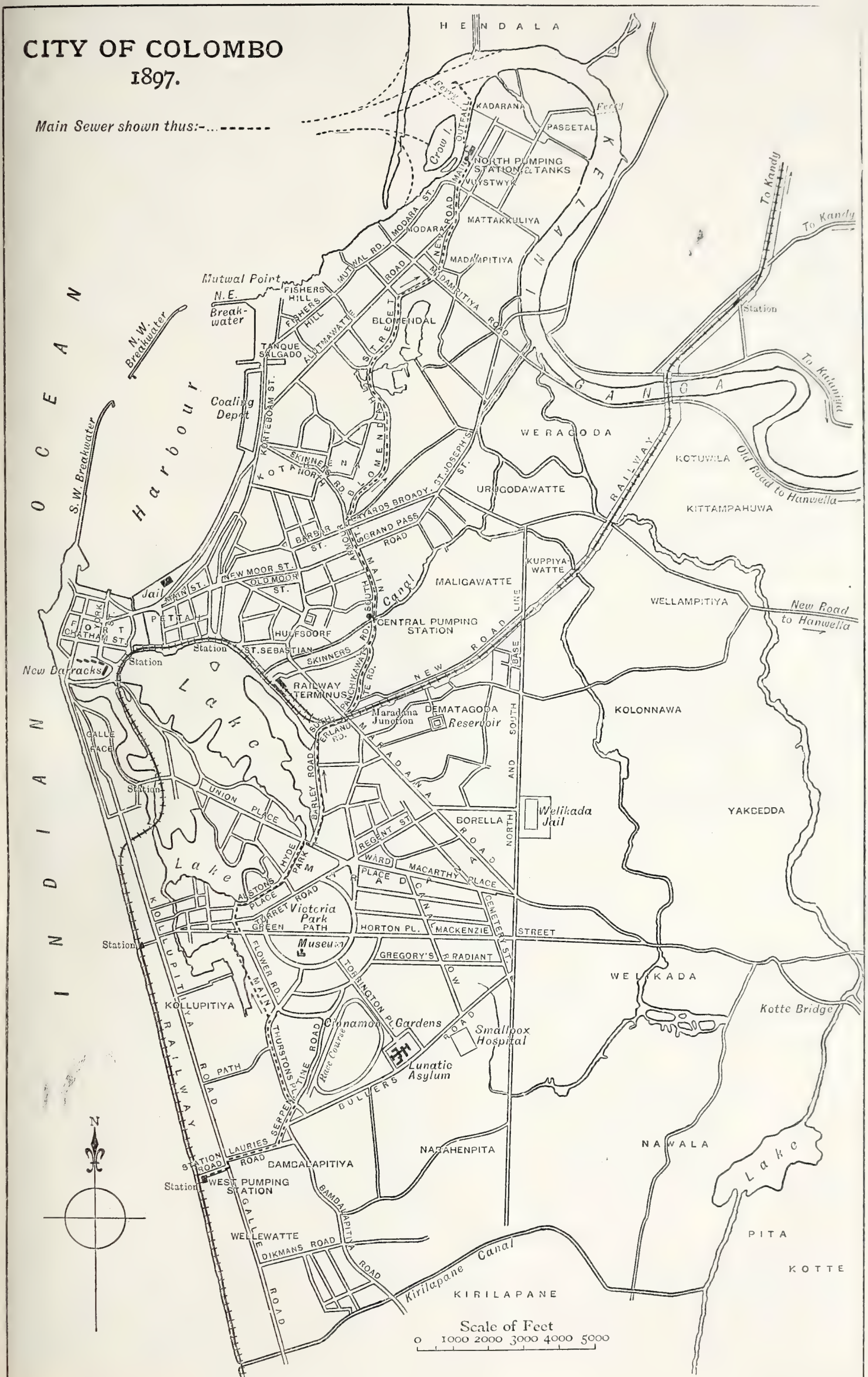
But now, having touched on Colombo as seen in the Thirties and Forties, the years of a big garrison, small trade, and the start of planting, I must show what it was like in the Fifties after our great Governor Sir Henry Ward gave so great an impetus to roads, bridges, and irrigation works through Major Skinner's department, and through Captain (afterwards General) Gosset, R.E., multiplied land surveys and sales, while he further started the great railway between Colombo and Kandy. I have had two pictures presented to me in writing, one by an official, the present Master Attendant of Colombo (Capt. Donnan), who has lived to see the breakwater which he first advocated for that port in 1864 completed; and the other from a planting friend, Mr. Wade Jenkins. Both landed in Colombo over 40 years ago. Capt. Donnan says he found in 1858 about a dozen sailing vessels from 300 to 1,000 tons at anchor in the outer roads, and perhaps a dozen or more native craft in the inner roadstead, and it seemed to him shipping operations were carried on safely and with some expedition; but he changed his mind when the monsoon set in. To Mr. Jenkins, in 1857, Colombo seemed a busy but truly oriental city, the Europeans few and far between; while coaches and sailing ships were in evidence where railways and steamers now prevail. There was but one hotel and one boarding-house (and those insignificant) in the place; but mercantile hospitality made up for this deficiency, and indeed the whole of the little European civil community seemed to regard each other very much as one family, and newcomers—generally arriving round the Cape, which was the almost invariable route for ladies and children, with a voyage of 85 to 105 days—were heartily welcomed as dear friends from the homeland. Such was my own experience on landing in Ceylon in November, 1861; but it was my good fortune to voyage out, not by the Cape, but by the P. and O. steamer *Pera*, under Commodore Jameson, from Southampton to Alexandria, to spend some days in Cairo before the European era, when that town truly represented the "Arabian Nights;" and to voyage from Suez to Point de Galle in the same Company's *Simla*, which often gave us a London mail even in those far-off days in 18 or 19 days. I found the mail coach journey from Galle to Colombo one of special and continuous interest, being never out of sight of a wayside hut or coco-nut palm for the whole length of 72 miles; while the naked native children, sitting on mother earth and clapping their sides as we galloped by, seemed the perfection of contentment with little, nay with absolutely nothing, save the banana they longed to pluck from the plant overshadowing them! I found the road near Colombo crowded with native pedestrians, with hackeries—tiny gigs drawn by small Sinhalese bullocks with deer-like legs and feet—or with the larger bandies drawn each by a pair of large Indian bullocks. There were a few carriages as we got to the city, many being of the old palankin shape, but seldom occupied by any save pale-faced Europeans, and the respectful attitude of the natives as these passed by was remarkable. Here, again, the last thirty years has wrought a marked change; there are as many horses and carriages used in Colombo now by wealthy natives as by colonists, and the rule of "Jack is as good as his master" is almost too freely illustrated as the hack-

eries of Sinhalese dash by and race, and even pass, the equipages of Europeans, of the respectable Dutch descendants, and of their own wealthy brethren. In 1861 we drove through Colpetty, the fashionable southern suburb, and across Galle Face, the maidan of Colombo, where all Society of an afternoon "eat the air," and ride on soft turf, drive on the smooth gravelled road, or promenade on the unequalled seaside walk constructed by order of Sir Henry Ward in the interests of the ladies and children of Colombo. Driving over a drawbridge across the moat, and passing through a heavy gateway with ponderous iron-studded doors guarded by a military sentry, the coach entered the old Dutch fort, built nearly 200 years earlier, and drove along a street shaded by rows of light green hibiscus trees with tulip-like flowers, merchants' offices and military quarters facing each other, while right in front was the campanile tower, built by Governor Ward to serve the double object of a clock-tower and lighthouse and still advantageously used for the same purpose, although nearly everything else is much changed in the Fort Ward of Colombo. On the other hand the Pettah, or native town, with its rows of one-storey shops and bazaars, stands much the same, with certain exceptions to be noted hereafter; while, in 1861, the principal bungalows lay along the Colpetty, Slave Island, and Mutwall roads—the Cinnamon Gardens, or New Colombo, being as yet unbuilt on.

Modern Colombo.

The first great change in modern Colombo took place in 1869 when Governor Sir Hercules Robinson got authority to demolish Cohorn's fortifications, obsolete as they were for purposes of defence, and requiring 6,000 men properly to man them. The levelling of the walls and filling up of the moat made the Fort much more accessible and healthy, an important matter since here all the banks and nearly all the mercantile offices, big retail stores, and Government offices, as well as some of the principal hotels, are found. Facing the sea, on the site of the old wall, military barracks were erected, and this handsome range of buildings, in an unequalled position for fresh air, is among the finest barracks for British troops in all the East. The military married quarters and hospital were at the same time erected on the side of Galle Face, and altogether these buildings added much to the appearance of the western side of the city. The disbandment of the local rifle regiment followed, most of the Malays and Sepoys being, however, drafted with their consent into a newly-constituted police force, and very much under their old officers. New banks and mercantile offices of two stories now became the rule in the Fort, the landlords and builders being chiefly wealthy natives, only too ready to invest their capital in big houses when assured of adequate rent. The old Oriental Bank, under its able and veteran manager, Mr. George Smyttan Duff (still alive and I suppose the *doyen*, as well as about the most successful of Eastern bankers), first led the way with a massive block of buildings. This is now occupied by the Hongkong and Shanghai and Chartered Banks; while we have besides in the Fort suitable and handsomely located branches of the Mercantile Bank and Bank of Madras, and more lately, though it has become almost our leading office, of the National Bank of India. This brings me to the later building developments within the Fort in the rise and expansion of the Grand Oriental Hotel and Wharf and Warehouse Company, of the Bristol Hotel, of a number of fine mercantile and public offices—notably our new General Post-office—and last of all the Victoria Arcade erected under the auspices of the Fort Land Company, which the present Governor has happily called the Fort Improvement Company, and in whose block, among others, the agency of the Peninsular and Oriental Company finds a fitting office. The lower portion (as in the case of the Grand Oriental Hotel) is fitted up for shops, principally dealers in the gems and curios for which Ceylon is famous, and the Victoria Arcade affords a nice place of rest and shelter to passengers or other visitors, while the first floor is occupied by offices, and above are residential flats, a new feature in Colombo. This modern block of buildings is a great improvement on the old godowns, and offers a pleasing indication of enterprise to fresh arrivals, as do also the new offices of the National Bank of India, to be followed by handsome stores and offices for our greatest importing house (Cargills, Limited), and farther on the handsome block now being erected for Mr. Davis, of Melbourne.

But I must also refer to the rise of "a new Colombo" in that portion of the city known as Cinnamon Gardens, and which was all covered with cinnamon bushes from Turret Road eastwards within my time. With wise prescience the Government first laid out an extensive park and flower gardens,



Walker & Boutall sc.

and then sold the surrounding land for building purposes. Here, then, within the past thirty years has sprung up a large number of residential bungalows in what is a favourite division of the town, intersected by delightful gravelled roads called after successive British governors. The most prominent building, and perhaps the most stately, with the finest site in the island, is the Colombo Museum, which we owe to the æsthetic taste and progressive spirit of Governor Sir Wm. Gregory, Mr. J. G. Smither being the very competent architect; just as Mr. Tomalin designed the new General Post Office, perhaps our next most imposing public edifice. At the farther end of the Cinnamon Gardens division, a Lunatic Asylum has been erected on a somewhat cumbrous plan; and in another direction will be found the group of buildings comprising the extensive Civil Hospital of Colombo in all its divisions, and the Medical Schools, much being due to private munificence, more particularly of the philanthropic Sinhalese De Soyza family, whose head first came into prominence through his splendid entertainment to H.R.H. the Duke of Edinburgh in 1870 at his Bambalapitya residence, since known as Alfred House. Time would fail me to remark on all the noteworthy edifices and institutions in the capital of Ceylon; but mention must be made of the grand old Wolfendalh Church, crowning an eminence overlooking the native town, and erected in 1746 for the Reformed Dutch Presbyterians. It is a massive building, and contains the graves of many of the Dutch Governors, whose names and arms are carved on the stone floor, or hung on the walls. Governor Gregory took a special interest in this structure, and presented some artistic windows to it. Then there is the Anglican Cathedral and College at Mutwall; St. Lucia's Roman Catholic Cathedral, and the several churches and chapels, mosques and temples, educational colleges and high schools in different parts of the town, belonging to the different religious bodies, as well as the colleges and schools of the Government. Then the town hall and market buildings should not be forgotten, any more than the public hall, with its fittings for concerts or theatricals. The law courts and several departmental offices are worthy of attention.

I have alluded to the Victoria Park, and it is satisfactory to know that in other parts of the town provision has been made for open spaces and recreation grounds,—the Campbell Gardens, the extensive Havelock racecourse, the golfing, hockey and cricket grounds, the racket court and Galle Face esplanade being prominent. The successful hold which the English game of cricket has taken on all classes of Ceylonese is sure to strike the visitor, who may see brown-skinned, bare-backed and bare-headed Sinhalese urchins playing the game as well as they can under their coco-nut palms with a branch of the tree, stripped and cut to make a bat, while the ball is of coir fibre, and the wickets, &c., are equally improvised after the simplest fashion. On the other hand, the Colombo Colts Cricket Club, composed of burghers and native young men, have achieved a name for themselves right over the island and beyond its limits, by defeating teams of young Englishmen, many of them fresh from leading public schools. Another sight worth mentioning as shewing the great advance of the people of Colombo, apart from the colonists, is thus referred to in a contribution before me:—

"Only the other day an immense throng was gathered on the Galle Face, behind the modern club house, to witness the Colombo inter-Collegiate Cricket Match, hundreds of fine equipages clustered about the enclosure, gaily and fashionably-dressed ladies and their husbands, brothers and sons filled the seats, and a big crowd encircled the ground all round—*with not a single European amongst them all.*"

Local Industries.

I must now refer to some of the industries specially associated with Colombo, and more particularly to those in native hands as of most general interest. But first let me say that in the height of the coffee-growing enterprise, 20,000 men, women and children (chiefly Sinhalese and Tamils) found employment in the large factories and stores of the merchants scattered over the town, where the coffee was cleaned, prepared, sorted, and packed for shipment. Tea, on the contrary, is prepared and packed on the estates; but there is a considerable amount of work still done in the Colombo stores, in sorting, blending, and repacking such teas as are sold at the local public sales; also in dealing with cacao, cardamoms, cinchona bark, and the remnant still left of coffee. Of greater interest will be found a visit in the proper season to a cinnamon store (such as that of Lady de Soyza) where the ingenious scraping, peeling, drying and quilling of the bark can be witnessed, all done very cleverly, though simply, by the special Chalia caste of cinnamon peelers. Cinnamon may be said to be the oldest of all exports from

Ceylon; for no doubt it was included in the spices traded for by the Arabs, who brought gold, silver, ivory, peacocks and apes (all found in Ceylon) to Solomon; while in the time of Augustus, Ceylon cinnamon was sold in Rome at the equivalent of £8 a pound weight, and so down through the centuries when Venice and Genoa commanded Eastern trade, followed by Portugal, Holland and Britain, until now the finest of our cinnamon can be got for less than 2s. a lb. Then we have in Colombo, some very extensive coco-nut oil mills, with hydraulic power, and fibre machinery, and mills for desiccated coco-nut—all well worth a visit.

Plumbago.

Next in interest, perhaps, are our Gems; but first I will take the one mineral of commercial importance, namely, graphite or Plumbago. It may not be generally known that Ceylon is the chief source of supply for this form of crystallised carbon, allied not simply to petroleum, peat, and coal, but also to amber and the diamond. It is so largely used in these modern days for the manufacture of metal-melting crucibles, especially in England and the United States, that the supply has not been equal to the demand, and the price has lately trebled, although our export is enormously increasing, so bringing wealth to a large number of Sinhalese, and exciting much interest as to the best means of extending the mining industry. One Ceylon estate proprietor, recently deceased (Mr. C. Tottenham) brought out a Cornish mining engineer to develop a mine on his land, and this has been done with success, both in an engineering and financial point of view, and now several large capitalists are beginning to turn their attention to Ceylon plumbago mines. One leading Sinhalese owner of mines (Mr. de Mel) confessed some 15 years ago that one plumbago mine had given him a net return of £2,000 a year for 11 years. The export is at present steadily increasing; and a very interesting sight in Colombo is to visit plumbago stores, where large numbers of women and children are employed picking out all foreign substances—such as pieces of ironstone—from the plumbago, and grading it according to quality before it is packed for shipment. The Ceylon trade in plumbago was first opened about 70 years ago, but by 1860 the total export was under 50,000 cwt., while last year (1898) it was 473,075 cwt.; and up to October 31st of the current year, 528,986 cwt. had been shipped—indicating an export of over 600,000 cwt. for 1899, while the value has risen from £25 to £75 per ton for the best quality. 1,692 plumbago mines and pits were reported in the island in 1898, and 412 "gem quarries." The most complete account of the plumbago industry is contained in a monograph by my relative, the late A. M. Ferguson; but it is impossible to do justice to the mineral resources of the island in this and other respects until we have a Geological and Mineralogical Survey of Ceylon—an undertaking I have long been pressing for—and which I am glad to think is, at last, about to be secured by our present energetic Governor. I believe it is no secret that the geological staff at present employed by Lord Cromer in Egypt is, in a few months, to be transferred to Ceylon; and so we may look forward not only to the wealth of the island in plumbago being approximately defined, but also to the settlement of long-vexed questions in reference to the existence of gold in paying quantities, of ironstone of a wonderfully pure character, and of the various precious stones so long associated with the island.

Gems.

Ceylon rubies, sapphires, catseyes, and other precious gems (which, with all their brilliancy, are simply crystallised clays), have been famous from time immemorial, and an industry is maintained in digging for the same up to the present time, in which some thousands of natives find a more or less precarious means of existence. The result of their labours cannot be tested, for most of the gems found, are privately sold and either transmitted by Colombo dealers to jewellers in London or Paris, or sold to the agents of Indian rajas and other purchasers. Almost the first experience of passengers and visitors as steamers anchor in Colombo, or on the boats, wharves, or if not, on each side of the first avenue entered, is to be accosted with, "Buy one ring," or "one very fine saffire, sar," or it may be a ruby or other stone:

> "And as engirdled figures crave
> Heed to thy bosom's glittering store,
> We see Aladdin in his cave,
> We follow Sinbad on the shore."

The shops of numerous native dealers are full of such gems, as well as of jewellery, carved ivory, tortoiseshell and other work; but the origin of a good many of the stones and rings may be traced to Birmingham; and in Governor Gregory's "Autobiography," several experiences are specifically related which may

be taken as fairly illustrating a not uncommon experience; indeed, few residents in, or visitors to, Ceylon, do not know of the ring with "stone" offered at £50, £20, £10, or £5, and eventually sold as a bargain (because a piece of glass) at a rupee or less! Still there can be no doubt that valuable gems have been found in Ceylon from time immemorial. Many Eastern nations knew Lanka of old to be the land of the hyacinth and ruby. The name "Ratnapura" (the capital of the gemming country) means the "town of gems;" and not unfrequently now an exceptionally fine ruby, sapphire, emerald, topaz, catseye, or large piece of Alexandrite fresh from the Ratnapura or Matara district, is placed on show in Colombo by its native owner. Europeans have tried to develop this industry; experts like Mr. Barrington Brown have reported favourably of the hidden riches; but the difficulty has always been to prevent the clever appropriation of gems when found in the clay by the native workmen, who can pick them up with their toes, conceal them in their hair or swallow them. To check this, an ingenious machine working on the principle of the specific gravity of precious stones and metals has been invented by Mr. W. S. Lockhart, M.Inst.C.E. (who had experience to guide him in the Burma ruby mines), and a "Ceylon Prospecting Syndicate" sent out a set of this machinery capable of dealing with 50 tons of gravel a day. The patent machine worked admirably, and many gems were the result; but owing to the pits not being sunk deep enough to get to the gem-clay, the return so far has not proved a financial success, although I am glad to learn that with increased capital the company is likely to go to work on a larger scale, and develop what I feel sure ought to be a very profitable industry. Good gems such as are found in Ceylon are at this moment in great demand in London and Paris, and I cannot see why with such reliable and advantageous machinery financial success should not be achieved so soon as the lower beds are struck. Mr. Lockhart will exhibit a diagram of his patent on the screen later on, and although I have no personal connection with the enterprise, I feel it right to refer to an invention that may have important results for Ceylon (and other countries), not only as regards precious stones, but also precious metals, especially gold where found in the alluvial.

Whether the geologists will be able to widen the gem-yielding area—at present confined to two districts, Ratnapura, or Rakwane and Matara—remains to be seen. Sir Samuel Baker some years before his death paid a visit to Ceylon—with which his name as sportsman, agriculturist, and author was closely related 50 years ago—in connection, I believe, with gem or gold exploration; but nothing came of it. Gem-digging, like gambling, has great attractions for the Sinhalese, and probably 50,000 of them altogether find employment in connection with plumbago mining and gem-digging; while the old industry of smelting with charcoal the iron ore found in many parts of the country has almost entirely died out. It is possible, however, that if any large quantities of this ore (with from 70 per cent. upwards of pure metal) were found on the banks of a navigable stream, it would pay, with cheap freight, to transport it to Europe, so adding to the trade of Colombo. No coal, not even in the form of anthracite—long supposed to be present—has been found in Ceylon.

Pearls.

Before passing away from Ceylon gems, familiar to the ancient Greeks and Romans, as well as to the Hindus and Chinese, I must refer to another allied precious product derived from the pearl oyster fisheries of the Gulf of Manaar. Known and famous from very early times, the native kings had for one of their titles, "Master of the Fisheries of Pearl." When titles were being sought for the sons of H.R.H. the Prince of Wales (some 25 years ago) I remember suggesting that Eastern cities should not be forgotten, that the then second son, now the Duke of York, might well be made Duke of Bombay, Colombo, or Calcutta, or Prince of Kandy. My suggestion was copied into the London *Times*; but in the following week *Punch* improved on it by showing that Prince George at his then age would probably prefer to be "Prince of Sugar-candy!" The existence of pearl fisheries for generations off the coast, and the absence of limestone in the low-lying country of Ceylon, was evidenced, as already mentioned, by the Portuguese when they built the first Fort of Colombo early in the 16th century, carrying many shiploads of pearl shells from Aripo to burn them for lime to use as mortar. There are no records of results in Portuguese times; but the Dutch frequently had good fisheries for several successive years, alternating with as many annual blanks. Thus in the four years, 1747-50, the Dutch netted pearls to the value of £130,000. Then in the first four years of our occupation, 1796-99, the British

got a revenue of no less than £342,000. After that, fisheries fell off grievously till 1814, which gave £105,000, and then a comparative blank till 1828, when four years yielded £120,000; the years, 1833 to 1837, gave £108,000; but then came a long interval with no fishery till 1855, since when the richest returns were £51,000 in 1863, £60,000 in 1881, £80,000 in 1888, and over £96,000 in 1891. For eight years now there has been no fishery. Altogether the British Government has secured from this welcome source of revenue, this "harvest of the seas," no less than the equivalent of £1,000,000 sterling after deducting all expenses. The accounts have been kept very carefully for 60 years, during which 345,000,000 of oysters were fished, two-thirds of which were sold by auction for Government, the rest going to the divers, the average price being £2 10s. per 1,000; one year, in 1860, the price rose to nearly £13 (again, in 1857, falling to 16s.) according to the size of the pearls found, a perfectly round pearl of large size and silky white lustre being greatly valued by Indian rajas, who would pay up to £200 for such a one. Pearl oysters are of mature age in the sixth year; but they often die off then, so that fisheries have to be fixed for the fourth or fifth year to make sure of the harvest, the information being obtained by annual inspections with native divers on the banks where the oysters locate and breed. Several Governors of Ceylon have taken a special interest in trying to guard against the many enemies to which the pearl oyster is liable; and Sir Hercules Robinson (afterwards Lord Rosmead) had out a trained naturalist who during several years wrote interesting reports on the results of his investigation, but failed to suggest anything practicable by which we might guard against adverse currents sweeping off the oyster beds, or shoals of voracious skates which sometimes devour the young oysters by millions; and to such or similar causes, the present veteran inspector of our pearl banks (Capt. Donnan) attributes the fact that there has been no pearl fishery since 1891, and that there is no prospect at present of one for some years to come. But considering all that science and practical skill have done in the breeding of the edible oyster off the British, French, and Italian coasts, and of the increased knowledge of ocean currents and marine zoology generally within the past 20 years, I think the time has come for a fresh scientific inquiry into the Pearl Oyster Fisheries of the Gulf of Manaar, by calling in the most competent naturalists and experts available. In this inquiry, the Indian might well join with the Ceylon Government, because the former owns certain banks in the proximity of Tuticorin which occasionally yield a fishery.

Silversmiths.

Pearls, like gems, give occupation to a separate caste of the Sinhalese—the silversmiths, after whom a special street in the native town is called—and a large number continue to manufacture jewellery, there being some 500 "silversmiths' workshops" in the Western Province. Operations are carried on in a very simple way, so far as tools are concerned, and generally as they were 1,500 or or 2,000 years ago. Tamils or Moormen, as well as Sinhalese now engage in the occupation. Gems are often badly cut by the natives, and their mounting is also not secure. A great deal of tortoiseshell work is found in the bazaars, as also carvings in ivory, ebony, &c., and there is a widespread trade in local pottery; while the shops with locally-made furniture should be visited, and Mr. Don Carolis especially has made a name not only in Ceylon, but in India, Australia, and even in London, for some of his cabinet work. An annual Art Exhibition in Colombo affords some encouragement to local talent, not only in painting, but in photographing, designing, and in art metalwork. The native lace of the Sinhalese women should be mentioned; it is freely offered for sale to passengers and visitors, and some is both good and cheap; while purchasers have the satisfaction of encouraging many industrious villagers, most of whom owe their training to mission schools.

Population.

Before dealing with industries, I should have specified the details of the population of Colombo. At the beginning of the century the estimate was that the town held 30,000 to 50,000 people. The first regular census, that of 1871, gave a total of 95,000 including 2,500 for the military and the sailors in the harbour; 1881 gave 112,000; 1891 made it 128,000; and it is with good reason supposed that the population now equals 150,000, including Tamil immigrants from Southern India. Every Eastern race will be found represented, and the native streets and bazaars present a most striking picture as the effeminate Sinhalese men with their long black hair tied in a knot surrounded by a comb—the women of the

human race—are contrasted with the darker, sturdier Tamils, or the fat Nattucotta Chetties, or still more with the big stalwart Moormen—many of them veritable father Abrahams or Ishmaelites; while one or two Chinese, some Kaffirs, Afghans, Bengalis, and a sprinkling of the paler and richer Parsees of Bombay, add further variety.

Sanitation, &c.

As regards the amenities of the city, it cannot yet be said to be altogether well lighted, although gas introduced 20 years ago (chiefly through the efforts of Sir John Grinlinton) with incandescent lamps, and even electric lighting of recent times in the Fort, hotels, clubs, &c., have made a great improvement. Colombo is a town of magnificent distances, and it is difficult to overtake its requirements fully in lighting. More important is a good supply of pure water, and this was brought to us by Mr. Bateman and his lieutenant, Mr. Burnett, by a scheme which tapped a hilly region, specially reserved, some 30 miles off. The piping is now being duplicated so as to make the supply adequate for all requirements; but Bombay in its experience of plague, the germs of which revel in a damp soil, has taught us the danger of an Eastern town becoming water-logged through provision by means of adequate drainage, not being made to take away the waste or surplus water supply. Colombo—in the flat portion of its Pettah, or native town, especially — stands much in need of systematic drainage, and the present Governor has had a survey, report, and estimate from a leading London sanitary authority, Mr. James Mansergh, M.Inst.C.E., on which, we trust, action may ere long be taken. The disposal of sewage by burning and burying is effectually carried out, and sanitation is as well attended to as it can be in a tropical town without systematic drainage, and with a people, many of whom do not understand that "cleanliness is next to godliness."

Time would fail me to speak of social progress among the people, of what the different Christain Missions with their schools have done to educate and uplift them — English being freely spoken and read by the natives in Colombo—or, again, of the drawbacks in the multiplied sale of arrack and other intoxicating drinks, and of opium which, so far as Ceylon is concerned, ought to be confined as in England to licensed apothecaries. Steps are being taken to mitigate these evils.

Railways and Tramways.

I now come to what the railway has done for Colombo. The grand mountain line to the interior, to Kandy, Matala, Nawalapitya, Dimbula, and Uva has concentrated the vast bulk of the planting traffic on the capital, and the new line about to be made to the north of Jaffna must still more centralise trade, especially in imports and exports. Sir Wm. Gregory carried a seaside line (extended by Sir Arthur Gordon to Galle and Matara) so as to traverse a considerable portion of the city, and in seven to nine stations from Maradana, through Pettah, Slave Island, and Kollupitiya, to serve a teeming town and suburban population as effectually as do the metropolitan underground lines. This is now to be supplemented by a line through Cotta (a district that feeds Colombo with working people, fruit, &c.), to the Kelani Valley tea district, and I maintain that the Government should lose no time in carrying this new 2½ feet line through the city to the north and on to Negomb (if not to Chilaw and Puttalam), so as to serve a dense population, a large number of whom is continually on the move, between the Pettah, Matakulya, Jayella, Neggombo, &c.

Through the enterprise of Messrs. Boustead Bros., their home supporters and engineers, Colombo has had for sometime now, a system of electric tramways at work on certain roads in the town and so far they have done well and in every way given satisfaction. Altogether the double line of tramways laid in Colombo cover two routes of 3½ miles each, on the 3½ feet gauge. The cars are neat and convenient and are well patronised, the people taking readily to this mode of locomotion, stimulated by the low fares charged. Considering that only two routes in the city are so far served, it is remarkable that a maximum of 25,000 passengers a day has been attained out of a total population of 150,000.*

* The following more explicit facts respecting the Colombo Electric Tramways and Lighting may be given:—(1) Two routes, each 3½ miles of double line, out of a proposed five routes converging from all parts of the town to a point within the Fort of Colombo, are already in operation. (2) The traffic is quite abnormal, and the present rolling-stock has proved quite insufficient to carry the passengers wishing to ride. About 15,000 a day are now travelling in ten to twelve cars, which ply from 6 a.m. to 10 p.m.; the rolling-stock will shortly be doubled. (3) The gauge is 3 ft. 6 in. (4) The power-house contains three units, one of 225, and two of 150 kilometres: a fourth unit of 300 kilometres is now being added. (5) A large and rapidly-increasing lighting business is being worked from the power-house through a small sub-station within the Fort of Colombo. A feature of

Colombo Harbour Works.

I have now to deal with the most important public undertaking in connection with Colombo, namely, the breakwater and other works, which are going to make it one of the most commodious and convenient artificial harbours in the world. I need not refer to the steps or reports which led Governor Sir Hercules Robinson finally to determine on, and Sir William Gregory to carry out, a breakwater at Colombo on the designs of the late Sir John Coode and executed under his direction by Mr. John Kyle. The foundation-stone was very auspiciously laid by H.R.H. The Prince of Wales, during his visit to the East in 1875. This grand wall, 4,212 feet long, took ten years and an outlay of £705,000 to complete. It changed an open roadstead into a harbour completely sheltered on the most exposed or south-west side; but there was still liability in certain months to storms from the north-west and north-east, and after much local discussion the Government at length decided to go on, and with Mr. J. H. Bostock, resident engineer, Messrs. Coode, Son, and Matthews are now carrying out two additional arms, (1) a north-east breakwater from the Mutwall shore, to be 1,100 feet long, and (2) an intermediate or north-west breakwater, 2,200 feet long, leaving two openings:—800 feet between it and the south-east arm, and another of 700 feet between the central and the north-east arms. These two additional arms, with lighthouses and connected works of land reclamation, coaling depôts, and other conveniences, are estimated to cost £527,000, the value of the work executed to the end of last year being £166,000. These works were commenced in April, 1894, and the firm estimated for completion in eight years, so that if nothing unforeseen occurs this extended harbour should be available for use in 1902.

Still more—apart from a patent slip, costing £33,000, now being made—a first-class graving dock has been sanctioned by Mr. Chamberlain for Colombo, half the cost (of £318,000) being borne by the Admiralty, on condition of Her Majesty's ships of war having a special claim to attention. Governor Sir West Ridgeway cut the first sod of this work on the 1st of March last with some ceremony, and the engineer, Mr. Matthews, as representing his firm, stated on that occasion:—The dock will be the largest of its kind in the Eastern Seas. It will be 600 feet in length on the floor, 113 feet in width between copings, and 63 feet at the bottom. Its entrance will be 85 feet in width, while it will have a depth of 32 feet over the sill at high-water, and 30 feet at low water of ordinary tides. To facilitate ingress and egress, a guide pier 700 feet in length will be formed on the north side of the entrance channel. It is estimated that this work will occupy about five years.

By 1903, or the beginning of 1904, the Colombo Harbour Works, costing from first to last not much less than £2,000,000, may be expected to be complete; and with the convenience of a first-class graving dock, as well as safe and commodious harbour, it is possible that the Admiralty may consider the prudence of removing the naval head-quarters from Trincomalee to Colombo. Be that as it may, there will be no want of steamers to occupy the harbour. Already as many as 15 to 20 large ocean-going steamers (five or six of them being often Peninsular and Oriental Company's mail steamers) have been counted at anchor in one day, and the tendency is steadily to increase as the central position of Colombo as a calling and coaling port—apart from local trade—is more and more realised. When the breakwaters are completed, the harbour will have an area of about 640 acres or one square mile, and will thus exceed the great National Harbour at Dover (now being made from designs by the same eminent firm of engineers), if the area of the "commercial harbour" already made be excluded. The depth of water inside the Colombo harbour will range to as much as 40 feet, and provision will be made for mooring to buoys quite 30 large ocean-going steamers.

The entrance to the dock will be made specially convenient, and there are to be separate coaling depôts for the Admiralty and for commercial purposes, while all the chief steamer companies, or their agents, will have their own coal stores. The justification for all this outlay on the part of Colombo is found, first, in the determination of the great British mail steamer company represented by our Chairman to shift its place of call from Point

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this business is a considerable day load caused by the use of slow speed oar-bladed fans, which have entirely superseded the punka. Arc lamps are now being erected along the main tramway routes, and alternating plant is being put down at the Power Station to serve the Galle Face Hotel, the Club, and the various residential portions of Colombo. When the remaining routes are opened to traffic, a possible goods business developed along the tramway routes, and the lighting mains extended throughout Colombo, the undertaking will be far the largest and most complete thing of its kind in the East.

COLOMBO HARBOUR
Plan of Proposed Improvements
1894.

Walker & Boutall sc.

de Galle to Colombo; nearly all other steamer companies—mail or commercial—trading with Eastern or Austral Asia doing the same. Then there is the splendidly-central position of Colombo, with reference not only to India and Australasia; but also in regard to Southern and Eastern Africa, the Straits, Eastern Archipelago, and China. Then there is the marvellous exemption of the port (and indeed the whole island) from the hurricanes which periodically devastate Mauritius; from the destructive cyclones which sometimes rage in the Bay of Bengal, but have never come farther south than the north of Ceylon; and, thirdly, from the earthquakes and volcanic eruptions which disturb Java and other islands of the Eastern Archipelago. Verily there was some reason for the first Mohammedan voyagers deciding that Ceylon must have been the home of Adam and Eve, and they accordingly proceeded to name the most prominent mountain Adam's Peak, and the coral reef between the island and India, Adam's Bridge! So heartily did Arabi and his fellow Egyptian exiles share this belief, that they at first treated their banishment to Ceylon with great satisfaction, and have certainly been as well off there as they would have been anywhere else in the world.

I have a few figures here to show the advance of the port of Colombo, beginning with the period 1835 to 1861, when steamers were practically unknown in its waters:—

SHIPPING ARRIVALS AT COLOMBO.

Year.	Ships.	Barks.	Brigs or Schooners.
1835	25	17	9
1845	25	32	13
1857	56	127	75
1861	82	90	131

The tonnage of the 303 vessels, in 1861, could not exceed 100,000, against a return now of some 3,000 vessels arriving, representing over 3,000,000 tons. The total tonnage for the port of Colombo, in and out, was 500,000 in 1870, just after the opening of the Suez Canal; it reached 1,400,000 tons in 1880; was over 4,000,000 tons for 1890, and is now in excess of 6,000,000 tons a year. Apart from the ready and economical freight thus provided to nearly all parts of the world, for the exports of this island, as many as 25,000 passengers call at Colombo in the year, some for a few hours, others for a day or two, while the practice of spending a week or two, or a month in the island is becoming common, and the day is approaching when Ceylon should rival Egypt as a place of winter resort. Already it is becoming a place of holiday resort for residents in many Indian towns and stations, at Rangoon and Singapore. In this connection it may be mentioned that Colombo has three first-class hotels, the finest in the East, besides that at Mount Lavinia, seven miles out, where is a favourite marine hotel with good sea bathing. Then, if Colombo is thought too hot to stay in long, Kandy, 1,650 feet above sea-level (where the nights are comparatively cool) has two good hotels, besides boarding-houses. Hatton, at 4,000 feet, has an Adam's Peak Hotel, and the sanatarium, Nuwera Elliya, at 6,200 feet, has also first-class hotel accommodation.

COLOMBO THE PORT FOR SOUTHERN INDIA.

Returning to the harbour, it is evident to any one who will study the map and note the absence of any good harbour on the Indian Malabar Coast up to Bombay, and on the Coromandel side, save what is afforded at Madras, that Colombo is destined to become the chief port for Southern India. Already passengers find it convenient to come there, assured they can find large steamers for the West, East, or South, and when railway communication—now extending to Paumben, in India, and shortly, no doubt, to Manaar, in Ceylon (as well as North of Jaffua) is united—as united it must be one day—across Adam's Bridge, and by the islands of Manaar and Ramisseram, we may expect produce and imports, as well as passengers, to pass to and from Colombo. I have already dealt with this subject in a paper read a few years ago before the London Chamber of Commerce, and afterwards at the Imperial Institute, and so need say no more now, than that two eminent engineers, having examined the route, have pronounced it feasible; and that if the military and strategic, as well as commercial interests of the Indian and Imperial, as well as the Ceylon Governments are fairly considered, the financial problem ought not to be insoluble. As a preparation for that day, I hold that the Ceylon authorities, as guided by the Colonial Office, ought to aim at a less restricted and more liberal policy in regard to Customs' tariff and dues at Colombo. The free port of Singapore, with its marvellous prosperity, is the example that should be aimed at, and when the

cadastral survey of Ceylon, begun by Governor Ridgeway, is complete, fiscal changes leading to a notable reform in the interests of the port of Colombo and of an Indo-Ceylon railway, ought to be practicable.

Ironworks and Foundries.

In connection with the harbour, I must not omit to notice the prominent and useful part taken by the Colombo Ironworks, covering three acres, and located close to the inner harbour, and the great service rendered there in the past in cases of disabled steamers, broken screw shafts or blades, or other casualties. The spirited proprietors, Messrs. Walker, Sons and Co., Limited, have provided a complete set of salvage gear; but steamers are so well built now and so well engineered that there are seldom serious breakdowns, and the heavy work of the firm is connected with the planting enterprises not only of Ceylon but Southern India, the Straits, Java, and even more distant parts of the world for tea, coffee, cacao and cocoa-nut oil machinery. Altogether about 1,000 Ceylonese find employment in these works supervised by some 30 European engineers, and no fewer than 200 steamers a year are served, the majority only requiring attention in light jobs. The same firm manages a steamer service round the island, which gives the outposts of Ceylon communication every week with Colombo. It has also promoted a Ceylon brick and tile company which is now manufacturing bricks in the neighbourhood of Colombo of special excellence. There are other foundries and factories doing useful work in Colombo, and employing larger numbers of natives, notably those of the Railway and Public Works, Messrs. Cave's, Hutson's, Colombo Commercial and Eastern Produce and Estates' Companies, &c. ; but the Colombo Ironworks established the first foundry, and is by far the largest. A solitary Cotton Spinning and Weaving Mill has not been a success so far, though in the hands of enterprising Parsees, it has now entered on a new career, I trust of prosperity in every way. Colombo is the scene of great activity in printing, publishing, and newspaper offices, chiefly in English, but also in the vernacular, an indication of the rapid spread of education. It is generally credited with publishing the most complete statistical handbook and directory of any colony of the British Empire ; while five daily English journals indicate greater enterprise than is found even in Bombay, Calcutta, or any other town in the East. In this connection our Buddhist fellow-subjects show considerable emulation both in educating and publishing, and it is a great pity that the people were not, some years ago, given a voice in regard to the disposal of Buddhist temporalities or endowments, which might do much to promote the vernacular, industrial, and technical instruction of the masses. I ought to say something about the Military Defences of Colombo ; but that is a thorny subject. There are several batteries, and there can be no doubt of the importance of adequately protecting this great coaling and trading station ; but although much money has been spent, a good deal has gone on what are now admitted to be blunders, such as the fortifications which broke up the amenities of the Galle Face Esplanade to no useful end. We can only trust that the latest batteries designed will meet with the full approval of our best military authorities. Here I should mention how useful the battalion of infantry stationed in Ceylon has proved in reference to military necessities elsewhere. The 37th Regiment was sent from Ceylon at short notice to Calcutta for the Indian Mutiny ; the Ceylon Rifles to Labuan, Hong Kong, and the Straits ; the 50th to New Zealand for the Maori War in 1863 ; the 57th and Dublin Fusiliers to South Africa ; and Sir West Ridgeway has offered Mr. Chamberlain the Highland Light Infantry, now in Ceylon, to go to Durban from Colombo, at any time, —our native population being most peaceable.

Visitors Arriving in Colombo.

It only remains to indicate in a few words what is most likely to impress a stranger arriving in Colombo. First, I never tire of quoting the pithy sentence with which Sir Emerson Tennent, the great historian of Ceylon, opens the first volume of his fascinating work. "Ceylon," he says most truly, "from whatever direction it is approached, unfolds a scene of loveliness and grandeur unsurpassed, if it be rivalled, by any land in the universe." Under favourable circumstances the towering and majestic cone of Adam's Peak, over 7,000 feet above sea level, and the subsidiary range of purple hills, should be noted as the coast is approached at break of day. The coral reef encircling a great part of the island is indicated by the snowy foam as the swell of the Indian Ocean breaks upon it. Anon, Colombo harbour is entered, and the rows of palms belting the shore to north and south divide attention with the evidences—in tower and spire rising above dense vegetation—of a considerable

city, still more emphasised by the abundant shipping and lively scenes within the breakwater. Acquaintance is made with the curious outrigger canoes of Ceylon—so often confounded by writers with the catamarans of India—as safe as many lifeboats and manned by almost nude humanity. Ashore, a kaleidoscopic scene of the many races already indicated as constituting the population, with every possible variety of skin and dress arrest the traveller; nor are modes of conveyance less varied, from the jinrickshaw (man-power carriage of the Japanese) introduced some 15 years ago, and multiplied in thousands, to the old-fashioned gharry or light American waggon, with its ample cover from the sun. A visit to the Pettah and fruit market may be followed by a drive along the most delightful carriage roads in the world, in the Cinnamon Gardens division of the city, while the wealth of vegetation in every direction makes one feel he is entering one vast botanic garden. The head-quarters and boarding schools of several of the Christian Missions, and even a Buddhist College and Schools deserve a visit, also the technical and agricultural colleges. Wherever the visitor travels over the ten square miles included in the municipality—for Colombo has its mayor and council board—there is novelty and variety in man and nature awaiting him. In some parts he may find himself in a perfect labyrinth of shady avenues, or lanes and flowery dells, or lagoons. In another, his conveyance will be climbing a steep street lined by old-world buildings of Portuguese or Dutch design, or again by the shutters and dead walls which indicate the seclusion of Hindus and Mohammedans in their family life. The seven miles drive through Colombo and beyond to Mount Lavinia, on the other hand, show the Sinhalese living almost in the open air, and their work and domestic duties may be watched in the open huts under their palms or plantains or jak fruit trees; while frequently there is a mingling of fowls, pigs, pretty little hump-backed bullocks and little brown-skinned children, which is quite bewildering. No one, I think, has ever seen Colombo (indeed, Ceylon) and said he was disappointed and unstirred in interest and curiosity.

The British Association and Colombo.

May I be permitted before I close, to allude to a suggestion made during the recent session of the British Association at Dover, and received with a fair measure of approval by some of the *savants* and members assembled there? It is that the meeting of this body for 1903 or 1904 should take place at Colombo, Ceylon. At first sight, "impossible" seems to be the word to apply to this proposal; but the more it is considered, the more possible I feel sure it will be considered to be. In the first place, the British Association has been twice to Canada, and it is quite time some other division of the Empire was favoured with a visit. Cape Colony is out of the question for a few years to come; any of the Australian capitals is too far away; and Colombo, though not so important in some respects, is far more central than Bombay or Calcutta. Visitors to meet the Association might well be expected from all parts of India, from Burma, the Straits, and even China, as well as Australasia; and we may feel sure that the novelty and interest of a meeting in a tropical town, in the most beautiful island in the world, would attract a considerable gathering.

The town, and especially the island, would in themselves be full of interest to a large proportion of the *savants* of the Association. Ceylon, the pearl of the British Crown colonies, among the most beautiful of tropical islands, is a little less in size than Ireland, with a varied population of over 3,000,000 (some 70 races being in all represented). It has been describod as a vast and most interesting botanical garden. The presence of a certain number of aborigines in the Veddahs at once makes it of special importance to the Anthropologist and Ethnologist; while our Sinhalese people in their history, their language, customs, and religion—Ceylon being the sacred land of Buddhism, and so regarded by Burmese and Siamese, as well as to some extent by Chinese—are full of interest to scientific men in many departments.

The island has been wonderfully opened up by first-class roads and railways, including a mountain line rising 6,200 feet above sea level, which is among the finest in the world, and which saves much time in reaching the jungle homes (if such they may be called) of the Veddahs, who live by hunting. Then the railway, projected by our present Governor, Sir West Ridgeway, and sanctioned by Mr. Chamberlain, and which will be finished by 1903, will be of special interest to learned visitors inasmuch as it will connect Anuradhapura—the ancient capital of the Sinhalese—with Colombo, involving but a few hours' journey, and so make the far-famed "Buried Cities" of Ceylon, with their dagobas, temples, and palaces, easily accessible. Not only

Anuradhapura, but Mehintale, the rock fortress of Sigiri, and the second ancient capital Pollanaruwa, could be visited, and the results of the Archæological Survey, liberally promoted by the present Government of Ceylon, could be inspected and judged on the spot. For the Geologist, Ceylon, with its primary rocks and absence of fossils, may be less interesting; but as the scene of successful gem-digging for rubies, sapphires, &c., from time immemorial, and as the great source in these modern days of graphite and plumbago—its one mineral of commercial importance—the island has an interest of its own; and a geological survey about to be commenced under Governor Ridgeway's auspices ought to have some important and interesting results by 1903. The fauna of the island are well worth attention, and the coral reefs around the island as well as the Maldives are even now the subject of elaborate investigations at the competent hands of Mr. Stanley Gardiner; while the pearl fishery of the Gulf of Manaar, in its history and successful operation, as well as enforced suspension for many years at a time, ought to furnish a subject for Zoological discussion of peculiar interest and practical value. For the Economist there is much to be noted in connection with native life and history, the system of public instruction in all its grades, the hospitals and asylums, as well as in the ancient and modern cultivation of cinnamon and palms, especially the cocoa-nut and palmyra; and in the rise within British times of great flourishing industries in coffee, cinchona, tea, cacao, and rubber growing, maintained on a system of free labour, and giving employment to some hundreds of thousands of Tamils from Southern India. Extensive operations in railway extension (including certain feeding lines on a very narrow gauge) just sanctioned by Mr. Chamberlain, and the grand breakwaters and graving dock now under construction at Colombo should afford much of interest to the Mechanical Engineer, who could not also fail to appreciate the good work shown in many of our river bridges and roads. Competent authorities from India and other surrounding countries might be expected to attend with papers of much interest in several departments; while there should be no lack of visitors from India and the Colonies, if not from Europe. Ceylon has now some of the finest hotels in the East, not simply in Colombo, but in Kandy, Hatton, Newera Elliya, and Galle. There would, I am sure, be abounding hospitality for the Association officials and other *savants* if a visit were arranged. The Government, which commands the railways and many other means of making a visit profitable and interesting, would, I am sure, feel any aid required to be a good investment, inasmuch as a Session of the British Association in Colombo would be a very valuable advertisement for the Colony, its attractions, industries, and resources. A large body of educated, intelligent, and loyal natives, both in Ceylon and India, could not fail to be specially interested in a visit of the British Association, and many would be ready to take a useful part in the proceedings, while all would rejoice in the means afforded by special lectures, papers, discussions, and excursions, of adding to their knowledge, and of meeting the leaders of the scientific world. Of course, there are difficulties, chiefly (1) in the length and cost of the voyage to and from Europe, and (2) in arranging for a suitable time of year. The best time for visiting Ceylon is between February and May; but it is not easy for British Association leaders, especially University workers, to leave at that time. For such, August-September would be more suitable, and these are by no means unfavourable months in Colombo. The Red Sea passage in August is very hot; but with modern swift steamers the ordeal is a brief one, and seldom trying on a first experience. There would be no chance of steamers being overcrowded at that season, and if a meeting of the British Association to Colombo were decided on, we have no doubt that the public-spirited Chairman of the Peninsular and Oriental Company and his fellow directors would offer every facility possible, to make the meeting a success. In any case, I must hope that many of my hearers may be able to visit the island that has been described as an Eden of the Eastern wave, and its capital, Colombo, among the most beautiful and most healthful of tropical and oriental cities.

We may now take the slides, and I would wish to acknowledge the courtesy and help given in respect of representations of the Harbour Works by Mr. W. Matthews, the Drainage area by Mr. Mansergh, and the Gemming operations by Mr. Lockhart, who each will explain these slides in a few words. I am also indebted for information to Mr. Donald Ferguson, Mr. Edmund Walker, and Mr. Boustead, while for the slides about to be shown I have to thank Mr. Martin Leake and the Ceylon Association, Mr. W. S. Bennett, and Mr. Jordan.

[The illustration of the City of Colombo is duced from a plan lent by Mr. James Mansergh, .P.Inst.C.E., and that of Colombo Harbour from ie lent by Mr. W. Matthews, M.Inst.C.E.]

.PPENDIX.—Bibliography of Ceylon and Colombo.

'rincipal writings on Ceylon at present (or shortly) available.

"Ceylon," by Sir J. Emerson Tennent, Kt., two olumes, illustrated (Longmans)—five editions—out of print—copies procured occasionally. (Apply A. M. and J. Ferguson, Colombo.)

"Ceylon: its attractions to Visitors and Settlers," by John Ferguson. ("Journal of the Royal Colonial Institute," No. 5, Session 1891-92—April, 1892.)

"One Hundred Years of British Rule in Ceylon," by L. B. Clarence, retired Judge of the Supreme Court of Ceylon. ("Journal of the Royal Colonial Institute," No. 5, April, 1896.)

"Murray's Handbook for India and Ceylon."

"Fifty Years in Ceylon: an autobiography of the late Major Skinner, C.M.G." (A. M. and J. Ferguson, *Observer* Office, Colombo.)

"Two Happy Years in Ceylon" (illustrated), by Miss Gordon-Cumming. (Blackwood; 1891.)

"Palms and Pearls, or Scenes in Ceylon" (illustrated), by Alan Walker. (R. Bentley and Son: 1892.)

"Picturesque Ceylon." A series of volumes, profusely illustrated, by H. W. Cave, M.A. (H. W. Cave and Co., Colombo.)

"India, Ceylon, Straits Settlements, &c." with two maps. (Kegan Paul, Trench, Trubner, and Co., Ltd., London, 1899.)

"The International Geography," by 70 authors, with 488 illustrations ("Ceylon," by J. Ferguson). Edited by Hugh Robt. Mill, D.Sc. (London: Geo. Newnes, Limited, 1899.)

"Ceylon Handbook and Directory for 1898-9," by J. Ferguson. (A. M. and J. Ferguson, Colombo.)

"Guide to Colombo," by George Skeen, 1899, illustrated. (A. M. and J. Ferguson, Colombo.)

"Guide to Kandy and Newera Elliya," also "Guide to the Buried Cities" (illustrated), by S. M. Burrows, M.A. (A. M. and J. Ferguson, Colombo.)

"Manuals on the Cultivation and Preparation of Coffee, Tea, Cacao, Rubber-yielding Trees, Spices, Fibres, &c.," edited by J. Ferguson. (A. M. and J. Ferguson, Colombo.)

"The Tropical Agriculturist for Planters" (published monthly), edited by J. Ferguson. (A. M. and J. Ferguson, Colombo.)

"Ceylon in 1900" (illustrated), by John Ferguson. Being a fifth edition of a popular history and guide to the island. (In the press.) (A. M. and J. Ferguson.)

Mr. W. Matthews, M.Inst. C.E., remarked that after the very clear reference to the Harbour Works at Colombo given by Mr. Ferguson in his admirable paper, it would not be necessary for him to refer at any length to the works in question. He might, however, be permitted to point out that the necessity for extended harbour accommodation at Colombo was brought about by the following causes: (1) By the necessity for increasing the area of sheltered water, due to the great expansion of trade; (2) the desirability of affording shelter during the north-east monsoon, when choppy seas prevail, which were inconvenient to passengers in landing and embarking, and also in the conveyance of goods to and from ships and the shore; the crowded condition of the margin of the harbour, and of the shore fringe thereof, at the southern end of the existing sheltered area, where traffic was only carried on amidst considerable congestion at the Custom-house premises. The necessity for increased warehouse accommodation in connection with the Custom-house departments entailed the removal of the existing coal depôts further north, and this could only be done by increasing the shelter. On these grounds, therefore, the additional sheltering works were authorised. The necessity for the Graving Dock arose from the fact that at present there is no dock suitable for berthing a warship of any magnitude between Malta and Hong-kong, and Malta and Australia respectively. Mr. Matthews showed some slides of the harbour works in progress, and explained the special features of each. He pointed out that during the south-west monsoon heavy ocean rollers strike the existing breakwater and throw up immense masses of spray, rising sometimes to a height of 100 feet. For six months in the year the sea beats continuously on this work, namely, from May to October, when the south-west monsoon prevails. From October to May, the period of the north-east monsoon, smooth water is predominant at sea, but as above intimated, occasionally a wind wave is generated during the day time which proves inconvenient to the carrying on of the business of the port. Mr. Matthews referred to the labour which is available for the carrying on of the works, which consists generally of Tamils imported from Southern India, who do most of the work corresponding with navvy operations in England. The skilled work is generally performed by the Sinhalese, who are good artisans. About 700 convicts are employed, generally in quarry operations. A considerable proportion of these have been incarcerated for the use of the knife. With regard to diving operations, although sharks undoubtedly exist in these waters, no case has occurred during the twenty-five years since the commencement of the works, of a diver having been attacked.

Mr. William S. Lockhart, M.Inst.C.E., in explaining the series of views illustrating mining and washing for precious stones, said Mr. Ferguson had mentioned the various stones found

in Ceylon. The most important of them, however, were the sapphires. There were sapphires of all colours, but the most beautiful, the cornflower blue, came from Ceylon. There were a great many other stones, all of value, and, next to the sapphires, rubies and cat's-eyes were the most important. They occurred in alluvial beds on the surface, from which the stones were obtained by open workings. Some also came from deeper-seated beds, consisting of the *débris* of decomposed rocks, but the workings might all be classed under the head of soft earth mining. The upper beds were worked open-cast, and the deeper beds, none of which were more than 200 feet in depth, by timbered pits and stopes. The gravel was brought up to the surface, and there the question of theft, which had ever been a bar to the development of this industry, came in. After having been washed, the gravel had to come to the picking table, and as picking and stealing seemed even more inseparable in Ceylon than elsewhere, it was from these picking tables, when the mines were conducted under European management, that the best gems always disappeared. To illustrate how clever the workmen were in this direction, he must narrate an incident which occurred to a friend of his whom he met on a P. and O. steamer. His friend had been to Ceylon ostensibly to shoot big game, but incidentally to pick up sapphires, and in the course of his wanderings had come across a mine worked by natives under European management. Having been shown round, he fell into conversation with the manager, as to the skill of the native pickers, he raising the further question, as to whether they did not occasionally pass stones over. The manager took half-a-dozen small sapphires, put them into a basket with some gravel, and then called one of the men and told him to pick it over. He did so, and his friend stood over him the whole time. In a quarter of an hour his task was completed, and the result was that no sapphires were found. The visitor turned round to the manager, with a suspicion of triumph in his eye, but the manager quietly said to the miner: "Now where are those stones?" and he took them all six out of his mouth, so that he not only had not missed them, but had conveyed them into his mouth under the spectator's very eye. There were no serious difficulties in connection with the work, except theft. [A map of Ceylon having been thrown on the screen, he pointed out the position of what is known as the gem-district, and also others where gems and alluvial gold are found.] The next view was a photograph taken in an open cast gem mine worked under European management. The last slide showed a diagram of the machinery that had now been introduced to wash the gravel and secure the precious stones, or gold, without having recourse to the picking tables at all. The plant shown was the one Mr. Ferguson had mentioned. It was capable of washing about 50 tons of gravel per day, and was driven by a small 6 horse-power engine. The gravel was shot (as the diagram showed) into the first machine, which was called a "grizzley;" here the clay was scrubbed down, and the large stones and rubbish ejected, and the portion containing the supphires then passed on to a puddling machine, which washed out what was left of the clay and the fine sand. The remainder was gravel between 1-8th inch and 1 inch mesh, and this was carried up by an elevator to a classifier, which screened it into eight sizes, each of which then passed to one of eight separators. These separators were the essential part of the plant, and took the place of the picking tables. Their action was simple, and, by taking advantage of the slightly greater specific gravity of precious stones, these separators were able to select them from the valueless quartz and other materials of which the gravel was composed. The mine manager alone had access to the receivers into which the precious stones found their way, and as the total deposit was not greater than could be dealt with by the European staff, the services of the native picker were not required at all. The entire cost of treatment by this machinery was under 6d. per ton, and it was believed that it solved the problem of dealing successfully with alluvial deposits containing precious stones and gold. When more plants of this character were set to work it was to be hoped that gem-mining in Ceylon would become the important and profitable industry the well-known extent of the gem-beds would seem to warrant.

DISCUSSION.

The CHAIRMAN said there was really very little time for discussion of this paper, but fortunately for him he was not called upon to discuss it. His simple duty was to propose a vote of thanks to Mr. Ferguson for the trouble he had taken. They would all agree, especially those who had been in Ceylon, that he had brought before them a picture, not of Colombo only, but of the beautiful island of Ceylon, such as they had hardly realised. Some years ago, a dramatic author wrote a letter to a newspaper saying his object in a certain play was to bring the scent of the hay-fields across the footlights, and those who had been in Ceylon must feel that Mr. Ferguson had been successful in bringing the scent of the cinnamon gardens into a lecture room in London. The story he had so admirably told was a story of which Englishmen were thoroughly proud, a story of progress and prosperity—not by any means unalloyed prosperity, but prosperity on the whole such as could be obtained by hard work, and by employing those natural advantages which most of our colonies possessed in a greater or less degree. In reflecting on this subject it was gratifying to know that the progress which Mr. Ferguson had described in connection with Colombo and Ceylon was by no means confined to that colony. From the Mediterranean to the furthest point of the East, including

Egypt, which must almost be considered a colony of Great Britain, India, Singapore, Hong-kong, in every direction they found the same progress and prosperity as had been described in connection with Colombo, and they found also that English spirit of loyalty prevailing throughout which made our Empire homogeneous both in time of peace and in a time of war. He had intended to make a speech about Ceylon himself, but after listening to Mr. Ferguson he thought discretion would be the better part of valour. He had intended to go back much further than Mr. Ferguson, whose history belonged to a somewhat modern era, and to tell them something about the voyages of the Phœnicians to Ceylon in old times, because there he should have been on ground where no one could contradict him, because the history was not written. They were all familiar with the fact that gems were very numerous in Ceylon, and they would not doubt his statement when he assured them that when the Queen of Sheba visited Solomon she had a necklace made of cat's-eyes, and that Solomon amongst his numerous domestic circle had a very large collection of Ceylon sapphires. Whatsoever the facts of that history might be, of one thing they were confident, that the trade in gems and spices was about the most ancient in the world. The trade in spices was one in which ancient Egypt was peculiarly interested, while the trade in gems was one in which the whole world, male and female, but especially female, was interested. They knew that that admirable ancient character, the Emperor Nero, burned more cinnamon and cassia at his wife's funeral than had been imported into Rome throughout the whole year, but he was not sure whether that was a testimony to the virtues of the wife or to the satisfaction he felt in assisting at that ceremony. Turning to the graver matters which Mr. Ferguson had been discussing, he might concur unquestionably in the view he had expressed that the colony of Ceylon had the greatest possible reason to be proud of that great work, the creation of the harbour of Colombo, and equally proud of her success in the wonderful trade in connection with tea. Those who visited Ceylon in the days before the breakwater was made could have no idea of what the appearance of a place like Colombo or Point de Galle was during the prevalence of the south-west monsoon. He himself was more familiar with Point de Galle at the time when the whole of the transhipment work in connection with the P. and O. steamers had to be carried on under circumstances of such extraordinary difficulty, owing to the weather which prevailed during the south-west monsoon, that he even now was filled with astonishment and wonder that it was carried on at all. In connection with this point Mr. Ferguson had told them how unfortunately there had hitherto been no coal discovered in Ceylon, but he could assure him that if he would employ the engineer who made the breakwater to drain the harbour at Point de Galle, he would find there were a few million tons of coal which had been lost from the P. and O. steamers. If the work which had been explored was creditable, the history of the tea trade in connection with India and Ceylon partook almost of the nature of the marvellous. It was hardly more than 40 years since Robert Fortune was travelling in China collecting the plants to make the first beginning of tea cultivation in India, and now between India and Ceylon the actual development of the tea trade amounted to upwards of 260,000,000 lbs., and very curiously he read only the other day in a letter that during the last year 1,000,000 lbs. of Indian or Ceylon tea had actually been exported to China. Another point which he thoroughly appreciated was the desire that Colombo should become as far as possible a free port, because there was nothing more mischievous in the world than to lay taxes on shipping. He regretted to say that this broad statesmanlike principle was not so well recognised as it ought to be. If Governments were wise they would look at such great examples as Mr. Ferguson had alluded to in Singapore, and to the still greater example in Hong-kong, where commerce in shipping was of gigantic proportions, and had been achieved wholly and solely to the fact that the port was free from taxes and dues of every possible kind. He must also endorse the view which had been expressed as to the desirability, almost the necessity, that an island so interesting as Ceylon should be much more widely known to the public than it was. The means of transit were safe, speedy, and economical, and if people would take into consideration how much profit the great section of the public which now spent its time and wasted its money on the Riviera every winter, more particularly at Monte Carlo, would derive from passing a similar length of time in Ceylon—that they could economise by travelling on anyone of the numerous lines of steamers that connected this country with that island, and there was no way of living so economical as on a steamship—if the public would only realise and carry out that idea as widely as possible they would benefit themselves to an enormous extent, and they would benefit Ceylon. Incidentally they might even do a little good to the P. and O Company, but that was the last thing he thought of in connection with a great public interest of this kind. He desired to thoroughly endorse Mr. Ferguson's wish that the Bristish public should be brought more into contact with that marvellous spirit of the East which was so splendidly shown in Ceylon, and which was at the same time so fascinating and so impossible to describe.

Sir JOHN GRINLINTON, in seconding the vote of thanks, said Mr. Ferguson had given them the result of more than thirty years' experience of Ceylon, and though he was there even before Mr. Ferguson it was impossible for him to add anything to what he had said. Mr. Ferguson had referred to the lighting of Colombo, and he must admit it had not been perfect,

inasmuch as the municipal revenues had not, in the past, been large enough to admit of a greater number of lamps, but within the last ten days a telegram had been received saying that the municipality had arranged to increase the number of lamps, and they were to be of the incandescent type, so that the town would soon be lit much better than many large English cities. The great prosperity of Ceylon was attributable to the advent of the planter, to the work which had been done in coffee and tea, and to the effect of the admirable laws which existed, under which everybody lived, European and native. The secret of the success of the British Empire through out the world was the equity of its laws, and he was quite certain there was not a single native in Ceylon who would not as soon, or sooner, be tried by an English judge than by one of his own people.

The vote of thanks having been passed unanimously,

Mr. FERGUSON, in reply, expressed his gratification at the meeting being presided over by the Chairman and representative of a company whose name was a household word in England. The P. and O. Company, which started as the Oriental Company in the Mediterranean, had developed and enlarged its borders to an enormous extent, and though there were other companies of a similar character, it still represented the British commerce and home life to those in the East in a way no other company could do.

Sir CHARLES KENNEDY, K.C.M.G.,C.B., expressed on behalf of the Society his great satisfaction at the success of that inaugural meeting of the section. They had begun the meetings of that section in the most auspicious manner. They were pleased to have as a Chairman one who both personally and also as representative of that great company which it would be found when the history of these latter years came to be fully written had done very much to promote British imperial and commercial interests, and to promote the welfare and comfort of the large number of passengers who travelled by its steamers.

SIR HENRY TRUEMAN WOOD writes :—

"I was sorry that the length of the discussion on his paper prevented me from keeping my promise to Mr. Ferguson to say something about his proposal that the British Association should be invited to meet in Ceylon. The suggestion is an important one, and ought to be carefully considered, not only with reference to a meeting in Ceylon, but with regard to the larger question of meetings of the Association outside the limits of the United Kingdom. Up to the present only two such meetings have been held—one at Montreal in 1884, and the other at Toronto in 1897. But there is, I think, no real reason why the work of the Association should not be extended over the whole of the Empire. Of course there are difficulties; but these will disappear. When it was proposed to hold a meeting in Canada, the idea was scouted as impracticable. It has since been found to be perfectly easy. No doubt the difficulties increase with the distance, but as they were overcome in the first instance as regards Canada, so they ought to be overcome with regard to the more distant portions of the Empire.

"The most important point is to secure a fit representation of British Science. It must be remembered that the Association consists largely of two classes—men of science, who do the work, and the more numerous members who, taking an interest in scientific matters, have joined at the different towns where the meetings have been held. This numerous and important class supplies the funds which the Association is enabled to devote to research purposes; but those who compose it cannot in any sense be regarded as representative men of science. No meeting can be successfully held unless a sufficient attendance of the former class is secured. As a rule, men of science are not men of wealth or men of leisure. It is only those who have retired from the active pursuit of their professions who can ever expect to get a three months' holiday in any year, and that amount of time would certainly be required for a visit to Colombo, not to say to Sydney or to Melbourne. A very large proportion of the workers of the Association belong to the professorial class. It is, of course, hopeless for them to think of getting away for months at a time, especially in the winter, the only suitable time for meetings in many of our colonies, nor as a rule can they afford so costly a trip.

"But if there is evidence of a desire among colonial men of science that they should have meetings of the Association in their own countries, and the Council of the Association can have sufficient evidence of this desire, they ought, I think, to consider the matter carefully, and try if they cannot elaborate a scheme by means of which the operations of the Association should be extended through the whole of the Empire. If it seems likely that a sufficient number of well-known scientific men would be willing to go to the Antipodes for a meeting, then let a meeting be organised at the Antipodes. If but a small number of scientific missionaries could be relied upon, then a solution might be found in the organisation of simultaneous or supplementary meetings of the Association which could be held without interfering with the regular sequence of the meetings in England. It is a grievance which is felt by many, especially of the older members of the Association, who are unable or disinclined to undertake foreign expeditions, that the regular sequence of meetings in England should be broken by holding meetings in distant parts of the Empire.

"I would venture therefore to express the hope that if invitations are received from Ceylon, and from other portions of the Empire, the Council of the Association will appoint a Committee with a view to

the preparation of a scheme by which the limits of the Association's regular work should be enlarged, and arrangements should be made for holding meetings in Colonial as well as in British cities. It would in most cases, I imagine, be possible to get together a sufficient number of representatives of the different sections of the Association to enable such meetings to be organised, and they could not fail to do good by bringing Colonial scientific men and scientific institutions more closely into touch with the institutions and the men of the mother country. In the meantime I hope that Mr. Ferguson will continue his efforts, and that the result of his labours may, at all events, be that the Association will receive a formal invitation to hold a meeting at such an extremely attractive centre as Colombo would appear to be."

FIFTH ORDINARY MEETING.

Wednesday, December 13, 1899; J. W. Bund Willis Bund in the chair.

The following candidates were proposed for election as members of the Society:—

Aird, Kenneth, 35, Bryanston-street, W.
Betts, William Henry, 2, Gray's-inn-place, Gray's-inn, W.C.
Crowden, Charles T., Motor Works, Leamington.
DeCastro, John Paul, Ford-house, Redruth, Cornwall.
Mowbray, Sir Robert Gray Cornish, Bart., 10, Little Stanhope-street, Mayfair, W.
Walker, Sydney F., Bloomfield-crescent, Bath.
Whipham, Dr. Thomas Tillyer, 11, Grosvenor-street, W.

The following candidates were balloted for and duly elected members of the Society:—

Baker, W. E., 27, Chancery-lane, W.C.
Cockell, Norman Alexander Lindsey, Glenisla, 18, Dorville-road, Lee, S.E.
Forester, Thomas, Phœnix Works, Longton, Staffs.
Hall, Thomas, 8, George-street, Edinburgh, and 25, Great Portland-street, W.
Longsdon, Henry Crofts, Phœnix Foundry, Keighley, Yorks.
Paten, Alfred John, City and Counties Club, Peterborough.
Pearce, Walter John, 68, Lansdowne-road, Didsbury.
Sandover, William, Ashburton, Richmond, Surrey.
Smith-Delacour, Ernest Walter, LL.D., Paramaribo, Surinam, Dutch Guiana.
Torrey, Edward Strong, 15, Britannia-street, King's-cross, W.C.
Wall, A. B., Oak Bank, Cheltenham.

The paper read was—

SEA ANGLING AND LEGISLATION.

By F. G. Aflalo.

That it is a great compliment to me to be invited to address you this evening goes, I am sure, without saying; but it is more, it is a great compliment to the branch of sport with which I delight to be associated that it should be permitted to occupy the attention of this meeting. On the question of freshwater fishery legislation, your records contain at any rate one address, delivered by the eminent legal authority who occupies the chair this evening; but sea angling as a sport, as distinguished from the economic problem connected with our sea fisheries, is certainly a subject new to this Society. I suppose a sport may fairly lay claim, whether it be in general practice or restricted to a few faithful adherents, to recognition as such from the moment at which it brings itself within the operation of the laws for public good. It is my object this evening to lay before you some reasons for so regarding sea angling, though, I may add, my proposals do not go as far as any recommendation for legislation. The evil is at present so slight that it can, I venture to think, be met by simpler and less unpopular means. If we can combat it by a moral example, as I hope to be able to show, there is not the somewhat invidious task of bringing the sport within the meaning of a new Act.

Before introducing to your notice the simple facts that have prompted my choice of a subject for this evening, may I be permitted to offer a word of explanation with reference to my object in addressing you, and in a matter that might otherwise be liable to misinterpretation. Six years ago it was my good fortune to be instrumental, with others here present, in founding what has since established itself as a society of great numerical strength and considerable influence. It is owing solely to the unfortunate coincidence that the weekly meetings of that body also fall on Wednesday evenings that many more of its members have been unable to avail themselves of your Secretary's invitation to be present here tonight. In their absence, I wish to say this: that there is in my mind no thought to propose *vexatious* legislation, or, for the matter of that, legislation of any kind; or to reflect in any way upon the sporting conduct of the members of that and other angling societies interested in salt-water fishing. The fact, however, remains (and this I think it is that

we should keep in mind) that, for every pier-fisher who belongs to one or other of these societies, there are fully a hundred who have never heard of either. I used, when secretary of the British Sea Anglers' Society, to find this ignorance humiliating, but the truth had to be faced. In considering the need, therefore, of taking account of amateur despoilers in any measures framed for the protection of undersized fish, I make no reference to the members of angling associations already pledged not to retain fish of less than certain scheduled lengths.

Between the laws that provide against the depletion of our rivers and those which are designed to keep up the future supply of our sea fish, marked differences exist. The chief difference lies perhaps in the relative difficulty of efficient supervision. It is a matter of comparative ease to appoint river bailiffs competent to suppress poaching on a limited stretch of fresh water, in river or lake. Observation is not difficult, and the offender cannot as a rule escape a well-planned attempt to apprehend him in the act. On the open seas, however, such a means of enforcing moderation would be impossible without at any rate the aid of fast police vessels able to overtake trawlers within the three mile limit. Nor is there the same co-operation on the part of interested fishery owners and riparian landlords. The protection of the inshore fisheries thus becomes in a measure everybody's business, which is, of course, nobody's business, and the most we hear of is the occasional capture of a luckless foreign trawler unable to catch the wind in time to get outside the limit. Many of the difficulties, however, that surround any attempt to legislate effectually against net fishing are fortunately lacking in the similar coercion of hookers, and it is with hooking that my subject concerns itself. There are, it is true, always a few yachting men who pass their time and keep their table supplied with trawls and trammels, in fine disregard of any rule or regulation. There was for years a particularly flagrant offender in the matter of trammelling bass on the Devon coast, until the neighbourhood of Exmouth was all but denuded of that fine fish. I do not wish to mention his name, but it is very well known to some here present this evening. The reprehensible fact of his conduct was that it ruined a number of the boat-owners and fishermen, who used bitterly to complain that sportsmen from town, who cared only for bass fishing, had ceased to come to the place at all, or, coming, no longer hired boats for the purpose. I have not heard so much of that gentleman's exploits of late years, but he was certainly the object of an extensively signed memorial, a copy of which I once had in my hands, on which the Board of Trade did not, if I remember right, see its way to act. Some valuable trammels, indeed—I forget at the moment whether they were his—were destroyed one night by the outraged men of Salterton, and in thus taking the law into their own hands, they certainly gave forcible expression to a sentiment wide spread along the whole coast of Devon. At the same time, netting fish is in no sense a sport, as we understand it, and it is not therefore permissible to bring these gentlemen within the category of sportsmen. It would not, in fact, be fair to the sportsmen themselves. Their offences should fall under the ordinary regulations affecting the practice of those who fish for their livelihood. We are therefore at liberty to confine the application of the term "amateur" to those only who fish for amusement with hook and line, with the rod or without, and this restriction considerably simplifies the terms of my inquiry and recommendations. Fishing of this sort is conducted from boats, from the shore, or from some pier or harbour. Now, to check the takes of boat-anglers would in many cases offer considerable difficulty. It is not perhaps necessary to detain you here with the various considerations that contribute to this; but I may just mention two—the difficulty of enlisting the co-operation of the boat-owners, men of small means and liberal views; and the difficulty of overhauling a catch made far from public observation and without the moral stimulus to upright conduct that we find when a number of strangers fish side by side on a pier. Before, however, showing you, as I hope to be able, that these boat-fishermen, while less easily checked, also constitute a less obvious source of danger to the well-being of the immature fish, it is desirable to form some clear idea of the class of fish more immediately threatened, and further to establish the greater simplicity of the conditions under which legislation affecting hookers only, as differentiated from those who fish with nets, might hopefully be framed.

With regard to the class of fish more particularly affected by the operations of the amateur, it is necessary to define certain lines of difference from those with which the professional fisherman usually concerns himself. Thus, whereas the sole is one of the problems of the future legislator, who will have to save

rom the trawl this fast disappearing and most valuable food fish, the amateur does little harm to it, for soles feed largely at night, and even then on the deep-water banks beyond the limits reached by the majority of those who fish for pleasure. The few amateurs who go out boat fishing at night are in pursuit of conger on the rocks, and they will not catch a sole in the course of a lifetime under such conditions. Some fish, like the pout and pollack, are of very slight commercial value; others, as the ling and hake, come but rarely within the sphere of amateur operations. While, however, only the flat fish need be considered on commercial grounds as marketable marine fishes, it is important to preserve, if possible, the bass, if only for the aforementioned reason that its capture by sportsmen gives work and wage to so many boatmen all around our coasts. Nor is it in fact wholly negligeable even from a food point of view, though personally I hold the lowest opinion of bass as a table fish. Pollack may perhaps be disregarded for present purposes. On economic grounds they so soon deteriorate as to have little or no market value. As game fish, they frequent the rocks in fairly deep water, and are for the most part able to keep away from the sweep of the trawl, and generally to take care of themselves. The bass, then, and the flatfishes are the kinds for which I shall endeavour to enlist your approval of further protection. In fine Novembers, I have known upwards of 300 small bass—miserable fish, none of which measured more than six inches in length—to be killed each week throughout the month, and even down to the middle of December, on Bournemouth pier alone. It is fortunate, indeed, that these irrepressible little fish do not come around our piers at a time when small boys are enjoying their holidays, else the destruction would be alarmingly increased. As it is, however, two or three thousand fish may in this way be killed at one single seaside resort during four or five weeks in each year, and there is a corresponding destruction of undersized flat fish throughout the remaining eleven months, and indeed side by side with the bass during the twelfth. There are two useful sources of information on such a subject. There is a wide acquaintance with many piers, and there is the close acquaintance all the year round with one. In a measure, I have employed both. There are very few piers in between Southend and the Lizard that I have not fished from, and there are very few days of the year that I do not see what is going on beneath Bournemouth Pier.

I now propose to put before you the reason why it is easier to protect the small fish from those who use hooks than from the operation of the netsman. To those of you who fish, the reason will be obvious; but for the benefit of the rest it should briefly be explained. When fishes are caught in nets, whether in trawl or trammel, they are as often as not dead when removed from the water. Very short hauls over a clean trawling ground may bring a per-centage of fish alive to the top, but I do not remember having seen more than, perhaps, fifty, here and there, that would, if returned to the sea, have lived; and these were in almost every case the larger, stronger fish, which it would under no reasonable law be imperative to set at liberty. Clearly, then, any common sense legislation aimed at the suppression of wasteful trawling must be framed to prohibit (if such prohibition be found possible) catching the fish in the first instance. With the protection of hooked fish, however, the circumstances are absolutely different, and the distinction is one that we must bear in mind. Save in exceptional cases, a sea-fish hooked while the angler holds the rod or hand line, as the case may be, has not time to take the hook so deep as to injure itself irremediably if at once unhooked with a little care and restored to the water. It may now and again happen that plaice and dabs will, even in the short space of a few seconds, take the hook so far down that the disgorger has to be used. It would be quite useless to return such fish to the water with any hope of recovery, since, even were the wounds not in themselves incurable, the chances are that the maimed state of the fish would soon attract the attention of sharks or dogfish. Such are, however, the exceptions, and in the ordinary way fishes would be little the worse for their few moments of fighting, and would, if at once released, swim off in comfort. Legislation, therefore, which takes account of hook-fishing, may quite reasonably prohibit retaining the undersized fish, an interdict that would, as we have seen, resemble, if applied to trawling, the proceeding of locking the stable door after the horse is killed. Again, it is very much easier to prevent a man keeping a very small fish which he has caught than to prevent him catching it in the first instance. In the former case the decision rests with him, but in the latter the fault lies as often as not with the fish. Once you launch a baited hook in the water, there is no saying what kind of fish, or of what

weight and size, will first snap it up. In river fishing, with which my acquaintance is strictly limited, I understand that it is in a measure conceivable that only a certain fish shall take a certain bait. But no one with any knowledge of sea fishing would seriously claim the same certainty for sea fish. Nor, apart from the nature of the bait used and the depth at which it is worked, is even the size of the hook much guarantee. I have often had blue sharks weighing 20 or 30 lbs. seize a hook intended for small mackerel; and, on the other hand, I have known the very small bass take a hook nearly half their own length in the shank. The mouth of a fish bears but a very indirect ratio to its length. The long garfish and broad flat-fish have comparatively narrow gapes, while that of the bass and pollack is enormous. So that not even the conscientious precaution of using a large hook is any reliable provision against catching a small fish; and the only plan, therefore, is to free the fish from the hook as delicately as possible, and at once return it to the sea. Unfortunately, this is exactly what the majority of pier-fishers do not care to do. The tiniest of flatfish are greedily retained. You may, on any fine morning, see these hung on strings to the chainwork, or more furtively thrust in some concealing bag or basket. In either case, they are kept; and if they were small even when fresh taken from the sea, they positively shrink to the dimensions of insects when the water evaporates. Among the worst offenders on our piers are small boys, deterred by the cost, and perhaps by other considerations, from going out in boats. Our open south-coast piers are not, as a rule, visited by the very small bass during the three recognised school holidays of the year; but, on the other hand, the baby flatfish suffer terribly, and, moreover, in one or two arms of the sea, such as Southampton Water, as well as in a number of docks, it is possible to catch the small bass almost all the year round.

I must now attempt to make more clear the statement I made before, to the effect that pier-fishers do more harm to the under-sized fish than those who fish in boats further out. It is fortunate indeed, as I think you will agree, that such is the case, for the pier fisher is much more easily controlled by local regulations. The fact is that our piers, those of wood more particularly, with a coating of mussels and limpets and weed, form shelters for all manner of inshore marine life. The calm water that lies, no matter what the direction of the wind, under the lee of these massive breakwaters offers quiet, and is in all probability less subject, as a rule, to abrupt variations in temperature than the unsheltered depths. I had hoped to lay before you in this particular connection some records made by myself with the aid of one of Negretti and Zambra's deep-sea thermometers, but bad weather and other obstacles have contributed during the past few weeks to prevent me from bringing my entries so near completion as to warrant my detaining you with them. I may say, however, that the few comparisons, ranging over two or three weeks at midday and again at four in the afternoon, that I was able to institute confirm, or tend at any rate to confirm, the suspicion that the temperature beneath our piers—I mean, of course, within the quadrilateral usually enclosed by the landing-stages—is on the average more equable than that of the water out in the open. Be the reasons what they may—and we are primarily concerned with facts, not with theories—the almost assured fact remains that more small fish usually congregate about our piers than in probably any ten times the area in the neighbourhood. Small fish are there in great numbers, and these are in turn followed by the larger fish, anxious to prey on them; and both large and small are then preyed on by the angler. It has been suggested that the fishes, or many of them, at any rate, assemble beneath our piers for the purpose of feeding on the smaller crustacean animals, the growing barnacles and limpets, with which the lower piles are covered. I have, however, watched for hours beneath Bournemouth pier, with the water clear as crystal, and saw no sign of such feeding, though if I include atherines and sand-eels, several hundred fish would often come within the field of observation. The smaller fish do not, I fancy, except perhaps in the 3 or 4 feet of water immediately behind the surf (a position in which the hand-seine often works irreparable damage) mass in the same way out in the open, and it is for this reason that I venture to assume that amateurs most threaten our fish supply when they conduct their operations from piers. Moreover boats are usually anchored immediately over, or at least very close to, rocks, for it is in such situations that the best sport is found, not only among the pollack and conger and other true rock fish, but also with the plaice and silver whiting, the finest of which are invariably taken in the hard sand or shingly ground on the edge of the reef. Out on the sandy ground, in the beaten track of trawlers, it is rarely worth

while anchoring one's boat; and that is where, spread over vast areas, and nowhere in such dense crowds as round our piers, the little flat fish are found. Our piers vary, of course, appreciably in this as in other respects. Whereas, for instance, at Dover or Hastings it is more usual to hook small pout or conger, at Southend, Bognor, or Bournemouth these baby flat fish are immediately taken by any small hook allowed to lie for a few moments on the bottom.

In contemplating the desirability of legislation for sea-anglers, I mean no more than that they ought to come within the meaning of any Act that applies within the three-mile limit to those who fish for their livelihood. I mean at present indeed rather less. And this recommendation I make to you quite irrespective of any opinion I may have ventured to form as to the efficacy of such legislation. The truth is that my faith in the remedial enactments of the past few years is a little shaken, the result, no doubt, of attending a number of conferences at the Fishmongers'-hall, as well as all the public deliberations of the last Select Committee in a manner that made it possible to read between the lines of the evidence, and to review the whole subject in lights not turned on it by the Blue-book. There are, to my way of thinking, too many who imagine it their immediate interest to break the law, and too few concerned to see it respected. The areas needing protection are too vast and too widely distributed for the effective supervision and control of a totally inadequate police. And the interests are too divided, the Scotch interests, the East Coast interests, and the interests of the Brixham district and of the West Country generally. It may be, then, that the future of our coast fisheries depends rather on those recuperative measures of hatching and re-stocking, in which we have, as regards, at any rate, the shad and cod, had some useful lessons from our friends on the other side of the Atlantic. In every other harvest, reaping implies sowing. The crops are nursed for many months, and harvested for one. Lands are allowed to lie fallow, that they may replenish their strength. There are, in fact, three aspects of this exhaustion and replenishment. There is the case, above indicated, of agriculture. Judicious moderation and scientific treatment combine to provide fresh resources for the coming year. There is the case of mines, in which the available supply, worked to the utmost limits of commercial profit, is fixed and incapable of recuperation. There is the third case, now before us, of fisheries, which should, in the ideal state, be treated in precisely the same way as agriculture, but which we seem far more inclined (so far, at least, as our sea fisheries go) to treat in the manner of mines, with the crowning injustice that we look for yearly renewal in face of our depredations, which no miner does.

Yet surely we have in a measure abandoned the *laissez faire* view that would consider the fishes of the sea as inexhaustible, capable for ever of maintaining their enormous numbers in face of the ever-increasing measures for their reduction. Even if we concede such phenomenal powers in the case of some migratory species, like the herring, we cannot allow it of more stationary kinds, like the flat fish, or, going yet lower than fishes, of the lobster and the oyster. This free and easy view of the powerlessness of unrestrained fishing to affect the supplies emanated from a very great biologist, no longer in our midst, but we may without presumption decline any longer to accept such a proposition in view of the growing demand and of the more efficient engines of destruction and means of locomotion everywhere at work. The steam trawler in its present vogue is a factor that puts a totally new complexion on the problem and its solution. Theory alone would contradict so optimistic a conclusion; the facts simply cry out against it. Every year our fishermen have to sail further and further away from home in search of certain marketable kinds of fish. Even the amateur feels it in his small and unimportant way. I could name you a score of piers on our coasts, on which, within my own limited experience, the fishing has almost steadily deteriorated year by year during the past twenty years. I shall be glad to hear of two on which the fishing can be shown in a like period to have maintained its quality; or of one on which it can be shown to have improved. The causes of this degeneration are not all over fishing, for increase of pleasure traffic may also be concerned in the result. But this operates during the summer months only, whereas amateur fishing goes on all the year, its more important season being indeed towards the end of the year, after the bulk of the steam traffic has ceased to trouble. Legislation has in any case not been effective. Re-stocking has not yet been given a serious trial on our coasts, though I believe that experiments have long been in progress at Plymouth and others of our marine laboratories.

Meanwhile, the work of depletion proceeds,

and my contention is that those whose business it is to safeguard the fisheries can afford to neglect no factor in this mischievous work, however restricted its operation. I do not for one moment say that the legislation will fulfil its purpose; but I do venture to say that it will one of these days have to be all-embracing, whether it succeeds or not. One amateur alone may mean an almost negligeable quantity compared with a trawler, but 20 amateurs fishing all the day from each of 300 piers, and during nine or ten months of the year, may tell an appreciable tale. Again, I do not say that any legislation has so far been devised that has successfully coped with either amateur or professional. I do not personally believe that it has. I wish I could feel any whole-hearted conviction that it ever will be. But if ever such measure should evolve from the deliberations at Westminster, and if it should be found easy of application and beneficial in its enforcement, why, then, apply it to, and enforce it on, the amateur with the rest. And, as already suggested, the pier-fisher, he who does the most damage, is more easily controlled than the rest. Fishing is practised on the majority of our piers only on sufferance, in most cases free of charge, often in admitted contravention of a dead-letter bye-law. Where a privilege is enjoyed on sufferance, its enjoyment can usually be made conditional; and there seems to me no reason why the pier authorities should not be either compelled, or at any rate induced, to request for the return, when unhooked, of all fish that fail to satisfy a minimum standard fixed in conference by some of the angling societies most interested. It is, perhaps, scarcely admissible to trouble you at this stage with matters of detail, but it does just occur to me to suggest that a small scale, showing the sizes for each fish, could, at nominal cost, be affixed to every post, the dubious fish being checked against the scale, and being returned to the sea if found wanting. I grant that the takes would diminish sensibly. On one of the few occasions on which in recent years I have angled expressly for flat fish, I recollect returning, in deference to a minimum of, I think, ten inches (by no means high, according to the sizes for plaice recorded by Messrs. Cunningham and Holt and Professor McIntosh), 53 plaice out of 71, or 75 per cent. Such restrictions would interfere with two classes only—the very young and the very greedy. No true sportsman would resent them. On the members of the angling societies above referred to they would have no fresh effect, since they already observe some such abstinence as unwritten law. That some action in this direction be urged on the directors of our piers seems to me both practicable and desirable. It would assuredly not require even the employment of the already overtaxed machinery of Parliament, for I imagine that the pier companies could in every case institute so beneficial a restriction on their own account. And the benefit to the inshore fisheries, the birthplace and nursery of so many species, would tell in no far distant future. It may be a small thing to save from destruction perhaps 200,000 fish every year. Regarded from one standpoint, it is a small thing. But the principle is the right one nevertheless, and the result would in the end make for good. It is a case in which, as in so many others, every little helps. We have recently seen how remarkably shilling donations aggregate to many thousands of pounds, and none but an idiot need, in view of the total, laugh at individual donations so trifling. Some of us have watched amateur sea-fishermen increase in the last ten years by hundreds. In the next ten we may see their numbers go up by thousands. Everything points to such a result. It is certainly easier to establish this restraint as a recognised condition of the sport before the ranks get out of hand. And so, I take it, even the amateur, asking to be brought within the meaning of the Act, inviting protection for the fish against himself and his class, renouncing the perfect liberty that a widespread indifference on these matters at present accords him, may, in his small way contribute towards the solution of a problem that unfortunately seems as far from solution now as ever it was.

DISCUSSION.

The CHAIRMAN said they were much indebted to Mr. Aflalo for this paper. He was very glad to find that he had the courage to say that the legislation, or rather no-legislation, undertaken some years ago under the auspices of a very great biologist, Professor Huxley, was a mistake. He had always been of that opinion. He admitted that the old Acts wanted reforming, and bringing up to date, but simply to sweep them all away under the idea that the reproductive powers of fish were so large that no legislation at all was required was about the greatest mistake the British Parliament ever made, which was saying a good deal. The result

d been seen all round our coasts. Not anglers ly, but fishermen of all kinds complained of the ormous decrease in sea-fish, and if the same thing ent on in a few years some kinds of fish would obably disappear altogether. He did not wish to ke a pessimistic view, but he knew the estuary of e Severn very well, and the decrease of sea-fish ere was most alarming; where they were formerly ught by thousands, it was difficult now to get undreds. On one or two points he did not quite gree with Mr. Aflalo, as for instance that it was an asy matter to appoint water-bailiffs on rivers. He ould give a good deal to anyone who would find im a good water-bailiff; you could get plenty of en, but not with all the requisite qualities. Four ings were wanted in such a man. He must have a ood constitution, a fair amount of courage, be ble to read well, and to give evidence well; and it as very difficult to find a man possessing all hese qualifications. After some 25 years expe-ience he was afraid he could number the really ood water-bailiffs he had met on the fingers of ne hand. With regard to fishing from piers, here was no doubt that fish crowded round any ixed structure in the tide, because it caused a sort of ackwater where they found food and shelter. He hoped the Sea Anglers societies did not ncourage those competitions which were so common vith fresh-water fishing, and which did more than nything to encourage the taking of immature fish. You got a number of people who went out for a day's leasure, often in a special train, to the river. They ook a certain amount of liquor with them. When hey arrived at the river, spaces were marked out for which they drew lots, they put in one or two rods, and caught fish a few inches long, and with two or three of these one of the party won a cup worth a considerable amount of money. Then they repaired to the nearest public-house, the landlord of which had probably taken an active part in getting up the competition, and ultimately returned home, probably not remembering what fish they had caught, or if they did, having rather exaggerated notions about them. Most of the piers belonged to private individuals or companies, who charged for admission, and could impose what conditions they pleased, and if they were properly approached they might be induced to say that they would only allow fishing under proper conditions, and in this way, without legislation, a great deal of good might be done. The destruction of small fish did no good to anyone, but did a great deal of harm; and he feared it could not be stopped by legislation. There were so many interests at work in Parliament, that he feared if any Bill were got through, it would either be ineffective or would make things worse.

Mr. C. H. Cook (John Bickerdyke) said he felt rather inclined to champion the cause of the small boy, for he remembered the many happy days he had spent on some of the piers, when they used to catch fish of some kind, but the only distinction they appreciated was that between flat fish and eels, and he fancied the satisfaction they derived from the sport was a good equivalent for the destruction they did to the sea fisheries of the country. He therefore hoped nothing would be done which would deprive the youngsters of this source of pleasure, which was also the means of teaching them something of natural history. In the life of Millais it appeared that when a boy of five he used to go fishing on the pier of St. Helier's; fishing led him to a love of sport generally, and of natural history; and from observing nature he took to painting it. As a boy he had very delicate health, and it was largely through his love of out-door sport, begun in this way, that his health improved, and he became what he was. With regard to bass and flat fish, he was entirely in accord with Mr. Aflalo. For many years there had been a great scarcity of bass, but during the last year small bass had increased enormously all round the coast, particularly in the estuaries of Devonshire, and they were being killed in thousands; it was stated in the *Field* that one person boasted of having caught several thousand with a fly-rod in the estuary of the Teign. With regard to flat fish, what was sauce for the goose was sauce for the gander, and in this case the goose was the man with the shrimp trawl, and the small trawlers who killed flat fish the size of a half-crown by the million; there was no comparison between the destruction caused by pier anglers and by shrimp trawlers. In 1894, Mr. Holt, of the Marine Biological Association, investigated this subject very carefully in the estuary of the Humber, and counted the number of flat fish caught in the shrimp trawls; he could not remember the exact figures, but he knew there were many hundreds in each haul, many of them turbot, of the size of half-a-crown. Of course these were returned to the water, but it was then too late; after they had been dragged through the water in a trawl net, in company with stones, hermit crabs, star fish, oyster shells, and so on, if they were not already killed, they were so injured that they would be naturally devoured by other fish. He was thoroughly in accord with the Chairman with regard to the views of Professor Huxley. Reading his works, which were always most lucid and convincing, it struck him that sometimes he drew his conclusions from insufficient data, particularly in this matter of sea fishing. The North Sea fisheries were now practically depleted, and the fishermen had to go right up to the Faroe Islands to catch fish. Difficulties arose with the Danish Government through our men endeavouring to steal Danish fish, because our home fisheries had been ruined. Speaking not as an Englishman but as a fisherman, he thought the Danes were quite right; they had so many fish that you could catch them with an unbaited hook, and in fact that was the common practice, and they had no occasion to use a trawl. Our men went there and put down trawls in their territorial waters,

and very properly the Danish Government did what they could to prevent it. If our own Government had taken similar steps round our own coasts, and had not been led away by scientific men who knew nothing about fishing, our fisheries would have been still left to us. To show the injury done by trawling, he might mention that some years ago when fishing in the Hebrides, near Stornaway, he found one part of the bay where you caught haddock as fast as you could pull them up, and the inhabitants told him it was the best place for haddock all round the coast, because they never let a trawler come there. He asked how they prevented it, and they said that if a trawler came they went out in a boat with guns and threatened to shoot them. On going again three years later he found there were, comparatively, no haddock, and was informed that several trawlers had come there in the night, and had practically emptied the bay of haddock. It would be ridiculous to wish for legislation with regard to piers, but with regard to bass some representation might be made. It was valuable as a sporting fish, and he thought it would be desirable to put up notices asking that undersized fish should be returned to the water. Such a request must be made by the British Sea Anglers' Society, the leading authority, at present, on all matters appertaining to sea fishing, because it had studied the subject, and he believed knew more about it than even the authorities of the Marine Biological Association. Its members were constantly gathering information, and were beginning to know a good deal more than professional fishermen. They were very enthusiastic, and he thought the time must come when they might be able even to advise the Government.

Mr. J. W. Woodall said he had served for some years as Chairman of the North Sea Fisheries Board, whose jurisdiction extended from the Tyne to the Humber, where there was an almost unique field for observation; and many of the facts already mentioned would be found embodied in their reports. The question of the three-mile limit had been fairly well thrashed out, and was conceded by all practical anglers, though Professor Macintosh and some others still doubted the advisability of enforcing it. It was certainly very useful as a means of keeping the peace between trawlers and long-line fishermen. He was sorry to say he had been considered for many years a great poacher. During 20 years he used to amuse himself very much with trawling, and often used to catch 1,000 pairs of soles, besides other large flat fish. He quite agreed with what had been said about Professor Huxley's views. He well recollected Professor Huxley coming round on the Commission, and even at that time, though he was then a younger man and could not say much, he thought he rather overstated his case. At that time there was no steam trawling, but since then there had been an entire revolution in the fishing on the north coast. Now there was one sailing trawler where formerly there were a hundred, and in a f years there would hardly be one left. He could co firm what had been said as to the injuri effects of trawling. He remembered one lit bay where he once trawled between the roc — it was a very small space — and got a f soles, but after that he never got another fish. S anglers might do a deal of good by impressing on t public the necessity for preserving young fish, and trusted they would be able to get rid of that sen mental weakness which possessed some legislators protecting what they called the poor fisherman, wh probably never did a real day's fishing in the yea but was much in the same category as the man wh poached for salmon or trout in spawning time in th upper reaches of the river.

Mr. A. W. Parker said it must be universal acknowledged that fish were diminishing, but one pro lific cause had not been alluded to, viz., the catchin of so-called whitebait. It was a shame that such name should be given, because it did not refer to an particular species, but to the young of fish tha happened to be there. He was once fishing o the south coast, several boats being out catching co but a steam trawler came along about a mile ou and in five minutes the whole of the fish disappeare and nobody caught another either that day or th next. He believed anglers would welcome legislation and that a little extension of Mundella's Act woul be very useful. He saw no reason why it should no be applied to trawling or net fishing of any kind.

Mr. G. R. Clarke, as a member of the Britis Sea Anglers' Association, desired to support Mr Aflalo. He had fished all round the coast, an could speak of the injury done by trawling. There was a beautiful bit of fishing ground at Deal, nea the pier, where the biggest plaice were caught, but it had been entirely destroyed by trawlers coming from Folkestone and Hastings. In days gone by pier fishing was very good, but during the last few years the fish had gone away, and the only chance now was to take a boat. Last time he was at Deal there was nothing to be caught at the pier, but going out in a boat he caught three and a half score of whiting, and two other gentlemen caught two cod, one 12 lb. and one 9 lb.

Mr. T. F. Aukland asked if the effect of steam trawling was not much more destructive than trawling by sailing vessel, owing to the greater speed at which the trawl net was dragged along. He had been given to understand that in many cases the fish were almost in a state of pulp.

Mr. Aflalo, in reply, said he could not give any exact statistics, but he believed the fish came up in the steam trawl in a much worse condition then they used to before steam was introduced. Still it was only a question of degree, and the young fish

me up in a sailing trawl, almost too hopelessly imed for it to be any use to return them. The am trawlers did not always go at full speed. It s for this reason he said that the returning of ung fish was only applicable in the case of angling. e was glad to hear Mr. Bickerdyke and Mr. oodall speak so plainly with regard to Professor uxley's deficiencies; he felt exactly the same, but cked the courage to say it: there was always the k of a brilliaut writer carrying the public with him, en if he were not quite certain about his facts and ures. The shrimp trawler was, in his opinion, solutely ungetatable. He believed he was at present der the restriction of the three mile limit, but he nstantly saw trawlers at work within half-a-mile of ournemouth.

Mr. C. H. Cook said there was no general w establishing the three mile limit. It depended n the regulations laid down by the Local Fishery oard.

Mr. Aflalo said he understood that the limit nly applied generally to the foreigner; and that eing so, what he had noticed was not a contra- ention of the law. He did not refer to trawlers the paper, because the scope of his remarks was onfined to amateurs, but he quite agreed with hat had been said. Within reasonable limits he as ready to admit the claim of the small boy, ut he thought he would get as much pleasure nd profit from catching the fish, examining it, nd putting it back again, as he could by keep- g it. If he took it home it would be very ttle but bone and discoloured water by the time got there. He was glad to hear the sugges- ion that the British Sea Anglers' Association nigh make some representation on the subject, regretted that more members were not present. owever, there was more than one member of the ommittee in the room, and he trusted they would ee their way to do something. He was only an *x-officio* member of the committee and, living at a listance, could not often attend the meetings, but if ny special meeting were called to consider the ques- ion he should be pleased to support it.

The Chairman then proposed a vote of thanks to Mr. Aflalo, which was carried unanimously, and the neeting adjourned

Miscellaneous.

WATER POWER IN NORWAY

A few miles from Christiania, the Glommen, Norway's largest river, forms a succession of waterfalls and rapids, which over a distance of about 1,100 yards possess a total fall of 62 feet. The catchment area of the river up to the point where it is proposed to utilise this water power amounts to some 15,000 square miles, while the minimum available volume of water is 3,500 cubic feet per second, the flow at the ordinary low-level mark being 5,250 cubic feet. However, by modifying the present weir across the exit of Lake Mjösen, the available flow might easily be doubled, and an output of 56,000 h.p. so obtained. For many years one of the best situated saw and polishing mills of the country has occupied a site near these falls, possessing rights at the same time over four-fifths of the available water power—that is to say, a maximum of 45,000 h.p. With a view to the erection of factories in the neighbourhood equipped for electrical running, a considerable area of the surrounding land has been acquired by the company owning the mills. A portion of the territory so acquired lends itself to the establishment of a river harbour. At the request of the company a report has been prepared by German engineers on the utilisation of the water power now running to waste. This report is understood to be very favourable to the proposed scheme, the cost of procuring an effective turbine plant capable of running without interruption promising to be extremely low, even though the powei could not be fully utilised at present. At the annual general meeting of the company it was decided to utilise 6,000 h.p. to 7,000 h.p. of the water power available—in addition to that already employed—for the manufacture of calcium carbide and the running of an electrical transmission plant, it being proposed to distribute current in Moss and the neighbouring manufacturing districts for lighting and power purposes. To this end the capital of the company was increased, and the directors of the company were authorised to negotiate with a large firm of electrical contractors with a view to carrying the scheme through.—*Electrical Engineer.*

ENGLISH EDUCATION EXHIBITION, 1900.

An English Education Exhibition will be held at the Imperial Institute, from the 5th to the 27th January. His Royal Highness the Prince of Wales has graciously consented to open the Exhibition on January 5th. The Exhibition will be arranged in the following five main divisions:—Education, as controlled by School Boards and Boards of Managers of Public Elementary Schools, together with Training Colleges for Teachers in Primary Schools; (2) Secondary Education, including (*a*) Boys' Preparatory Schools, (*b*) Private Schools, girls and boys, (*c*) Endowed and Proprietary Schools for girls, (*d*) Endowed, Proprietary, Grammar, and Public Schools for boys, (*e*), Secondary Training Colleges; (3) University and Higher Education; (4) Technical Education, with Schools of Art; (5) Educational Institutions and other bodies, not falling under any of the above heads.

Meetings for conferences, lectures, &c., will be held in connection with the Exhibition. Mr. J. Fisher Williams, 7 New-square, Lincoln's-inn, is Secretary to the Organising Committee.

Obituary.

Sir Charles Mitchell, G.C.M.G.—Lieutenant-Colonel Sir Charles Bullen Hugh Mitchell, Governor of the Straits Settlements, died on the 7th inst. Sir Charles Mitchell, the eldest son of Colonel Hugh Mitchell, R.M., was born in 1836. Entering the Royal Marines from the Royal Naval School in 1852, he obtained his lieutenant's commission in 1854, and served with the Baltic expeditions in 1854 and 1855, being employed in the rocket boats at the bombardment of Sveaborg and receiving the medal. He served with the expedition to the Baltic until the conclusion of peace in 1856. His career in the Colonial service began in 1866, when he was appointed Colonial Secretary of British Honduras, and he administered the government of that colony on three occasions, in 1870, 1874, and 1876-7. In 1877 he was transferred to British Guiana as Receiver-General, and in November of the same year he was appointed Colonial Secretary of Natal. He acted as Governor of Natal in 1881, 1882, and 1885-6. In 1886 he was appointed Governor of Fiji. In 1889 he again administered the Government of Natal and Zululand for a time, and was appointed Governor in October, remaining in that post till October, 1893, when he was nominated Governor of the Straits Settlements. Sir Charles Mitchell was elected a Member of the Society of Arts in 1896.

General Notes.

Livingstone Exhibition, 1900.—An Exhibition will be held in St. Martin's Town-hall from January 1 to January 5, under the auspices of the Livingstone College, with the support of the Royal Geographical Society. The object of the Exhibition is the promotion of the health and comfort of travellers or residents in foreign countries, by the display of such articles of outfit as are recommended by the best authorities as conducive to hygiene abroad. There will be demonstrations by the London School of Tropical Medicine in connection with the Exhibition.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings at 8 o'clock:—

December 20.—"Bi-Manual Training by Blackboard Drawing." By H. Bloomfield Bare, F.R.I.B.A. Walter Crane will preside.

MEETINGS FOR THE ENSUING WEEK

Monday, Dec. 18...British Architects, 9, Conduit-street, W., 8 p.m. Dr. A. S. Murray, "Decorative Patterns from Excavations in Cyprus in 1896."
Actuaries, Staples-inn Hall, Holborn, 5½ p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Dr. Andrew Wilson, "The Living Body and its Cell Citizens."

Tuesday, Dec. 19...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on paper by Mr. C. Newton Russell, "Combined Refuse-Destructors and Power-Plants." 2. Mr. Reginald A. Tatton, "The Purification of Water after its use in Manufactories." 3. Mr. W. O. E. Meade-King, "Purification of Waste-Water from Factories."
Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. G. H. Wood, "Some Statistics Relating to Working-class Progress since 1860."
Pathological, 20, Hanover-square, W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m. Capt. W. de W. Abney, "Negatives for Three Colour Work."
Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. W. L. Sclater, "Mammal-fauna of South Africa." 2. Mr. W. P. Pycraft, "Osteology of Birds" (Part IV. Pygopodes). 3. Messrs. B. C. A. Windle and F. G. Parsons, "The Myology of the Edentata" (Part II.).

Wednesday, Dec. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. H. Bloomfield Bare, "Bi-Manual Training by Blackboard Drawing."
Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. Baldwin Latham, "The Climatic Conditions necessary for the Propagation and Spread of Plague." 2. Mr. Robert H. Scott, "Note on a remarkable Dust Haze experienced at Teneriffe, Canary Islands, February, 1898."
Geological, Burlington-house, W., 8 p.m. 1. Mr. G. W. Lamplugh, "Some Effects of Earth Movements in the Carboniferous Volcanic Rocks of the Isle of Man." 2. Miss G. L. Elles, "The Zonal Classification of the Wenlock Shales of the Welsh Borderland." 3. Mr. T. Stephens, "An Intrusion of Diabase into Permo-Carboniferous Rocks at Frederick Henry Bay, Tasmania."
Microscopical, 20, Hanover-square, W., 8 p.m. Mr. Edmund J. Spitta, "A Review of Photomicrography and its different Methods."
Mining and Metallurgy, Geological Museum, Jermyn-street, S.W., 8 p.m. 1. Mr. H. Howard Greenway, "Notes on the Cyanide Process." 2. Mr. Spencer Cragoe, "Some Notes on the Chlorination Vat Process as Applied to the Auriferous Concentrates of the Santa Anna Mine, Brazil." 3. Mr. James Park, "Notes on the Coalfields of New Zealand." 4. Mr. S. O. Cowper-Coles, "On the Electro-Deposition of Chromium."

Thursday Dec. 21...Chemical, Burlington-house, W., 8½ p.m. 1. Mr. H. Jackson, "The Condensation of Glycollic Aldehyde and formation of α and β acrose." 2. Messrs. A. W. Gilbody and W. H. Perkin, junr., "Brasilin and Hæmatoxylin. Part III." 3. Messrs. N. E. Bowtell and W. H. Perkin, junr., "The Action of Alcoholic Potash on Monobromoglutaric Ester." 4. Dr. P. C. Rây, (i.) "Mercurous Iodide;" (ii.) "Interaction of Mercurous Nitrite and Ethyl Iodide."
Linnean, Burlington-house, W., 8 p.m. 1. Prof. Thos. W. Bridge, "The Air-bladder and its Connection with the Auditory Organ in the Notopteridæ." 2. Mr. F. Chapman, "Foraminifera from the Funafuti Atal."
Numismatic, 22, Albemarle-street, W., 7 p.m.

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No. 2,457. Vol. XLVIII.

FRIDAY, DECEMBER 22, 1899.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be given on Wednesday evenings, January 3 and 10, 1900, at 7 o'clock, by HERBERT JACKSON, on "The Phenomena of Phosphorescence."

The lectures will commence at 7 o'clock. Special tickets are required for these lectures, which can be obtained on application to the Secretary. A sufficient number of tickets to fill the room will be issued to members in the order in which applications are received, and the issue will then be discontinued. Subject to these conditions each member is entitled to a ticket admitting two children and an adult. Members requiring these tickets should apply at once.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by Members on application to the Secretary.

Proceedings of the Society.

INDIAN SECTION.

Thursday, December 14, 1899; Sir HENRY WYLIE NORMAN, G.C.B., G.C.M.G., in the chair.

The paper read was—

ROUND ABOUT THE ANDAMANS AND NICOBARS.

By COLONEL R. C. TEMPLE, C.I.E.

On the last occasion on which I had the honour to address the members of the Indian Section of the Society of Arts my subject related to the Penal Settlement at Port Blair in the Andaman Islands, of which I am the official Superintendent; but now I propose to take a much wider view, and give such an account as is possible within the limits of a paper of the territories comprised within the jurisdiction of the Chief Commissionership of the Andaman and Nicobar Islands.

As on the former occasion I must commence with some remarks on the geography of my subject, which, I trust, will in themselves not be without interest. Roughly speaking, the territory in the Chief Commissionership of the Andamans and Nicobars under the Government of India consists of a long and narrow string of very numerous islands running north and south down the middle of the Bay of Bengal. The extreme south of the Nicobar groups is within 100 miles of Sumatra, and the extreme north of the Andaman groups is somewhat further from the coast of Burma. The territory is thus about 600 miles long, and nowhere more than 40 miles wide.

Within the local jurisdiction are also included the curious outlying islands of Narcondam and Barren Island to the eastward, but not the Cocos and Preparis to the north, which are administered from Burma. I draw attention to this last fact, as it bears upon a point of paramount interest to us dwellers in these tropical islands, and of some general interest to all at the present time. It is the existence of these last groups, the Cocos and Preparis, that makes it physically possible to extend from the Burmese coast to the whole of the Andamans and Nicobars, and perhaps thence to Acheen in Sumatra, that system of wireless telegraphy which is now being brought into practical use.

The idea of setting up telegraphic communication between the Andamans and India is an old one, which has on more than one occasion reached the point of plans and estimates, because of the very great importance of both the Andamans and Nicobars as meteorological stations, whence timely warning of the formation, direction and strength of those terrible and frequent storms known as cyclones can be given to shipping all over the Bay of Bengal. But the overwhelming obstacles, hitherto, have been the physical difficulties of laying a cable, and the great cost thereof in this particular instance. However, the arrival of wireless telegraphy essentially changes the old conditions.

The point to get at is Port Blair, which is such a long way by sea from anywhere—roughly, 1,000 miles from Madras, 750 miles from Calcutta, 350 miles from Rangoon—that

at the first blush it is absurd to talk about reaching it by wireless telegraphy. But if you will carefully look at the general map on the screen, the apparent impossibility at once disappears. Roughly speaking, the Andamans on the one hand, and Narcondam, Barren Island, and the Invisible Bank on the other are in reality the tops of submerged mountain ranges connected with the Asiatic continent through Burma, while the Nicobars are the tops of a similar range connected with Sumatra. And, as a matter of fact, if the string of islands be viewed as a whole the longest distances from the coast of Burma, from each other and from Sumatra are quite trifling.

You will perceive that telegraphic communication could be set up along the whole line of islands, either by the wireless system alone or by its combination with the ordinary overland wires, the portion of the route which it would be obligatory to bridge over by wireless telegraphy being the sea stretches. These are all that need be considered now, and the lengths of the stretches in question are in no case prohibitive. At Diamond Island in the extreme north of the map is an important telegraph station, used by ships awaiting orders from Rangoon, Calcutta, &c., and for similar purposes. From Diamond Island to the Alguada Reef, where there is an important lighthouse, is only 10 miles; thence to Preparis Island, the distance is 55 miles; thence to the Cocos Islands, where is another important lighthouse, it is 45 miles; thence to Landfall Island it is 30 miles. On reaching Landfall Island we find ourselves in a long closely connected string of islands, along which ordinary wires could be stretched to Port Blair, 150 miles. Communication southwards from this point could be extended to the south of Little Andaman with the help of wireless telegraph stations, in no case more than 25 miles apart. From the Little Andaman to Car Nicobar we encounter our longest sea distance of 70 miles, but the distances onwards are not great: to Chowra, 40 miles; thence to Nancowry, 20 miles; thence to Little Nicobar another 20 miles, whence it is only 30 miles to Parsons Point in the extreme south of the Great Nicobar.

The meaning of all this is that the greatest sea distance to Port Blair is 55 miles, and onwards to the Nicobars it is 70 miles. Now, I am assured, and my own observations, made with the kind assistance of Mr. Marconi and his friends, have confirmed me in the belief that anything under 100 miles is not an impossible practical distance for wireless telegraphy; at any rate, 55 miles is an easily feasible distance.

To extend the line of telegraphic communication on to Sumatra we should find it 60 miles to Pulo Brasse, and then 15 miles to Acheen Head, whence communication can be run on by land and sea to Singapore or any other selected point in the general cable lines. In this way there could be set up an independent line of telegraph between India and the rest of the world. This, however, would involve co-operation with the Dutch East India Government and other political considerations we cannot enter into in this place. But leaving this point out of our present purview, the fact remains that it is quite feasible to run a line of wireless telegraph stations down the whole length of the Andamans and Nicobars in direct communication with Diamond Island, every one of which could without difficulty be turned into a meteorological reporting station, thus creating that series of stations which it is so essential to have for practically useful meteorological reports.

Now let us consider, on the one hand, the quantity and value of the shipping frequenting the Bay of Bengal, the extreme violence of the cyclones, the present difficulty in obtaining such accurate warning of them as will effectively prevent damage to shipping therefrom; and on the other hand, that though these islands in the Bay are not themselves liable to frequent attack by cyclones, they are within the influence of every one that occurs, usually four days and more, before any part of the coast of India; and then the practical value of a series of meteorological stations down them becomes at once apparent. I will go further, and say that considering the magnitude of the interests concerned, both as to lives and property, the point is worthy of the very serious consideration of the commercial communities both of this country and India. Its commercial importance is, indeed, shown by the fact that representatives from Lloyd's are in official attendance here this evening as well as representatives of the P. and O. and other steamship companies.

Viewed thus the possession of the Andaman and Nicobar Islands has an interest for the Empire at large quite apart from the great experiment in the treatment of convicts that has been there so long persevered in, and from the unique opportunities afforded for anthropological studies. Of their political value, I may say that the many splendid harbours and cosy

lets scattered throughout this group of islands ould give such safe shelter to an enter- ising and possibly inimical foreigner, and ave given such opportunities readily taken, ven within living memory, by the inhabitants both the Andamans and the Nicobars for iracy and wrecking, that their possession by ny one but ourselves has long been out of e question. Primarily the cause of their clusion in the British Empire has been the revention of that persistent and dangerous iracy and wrecking, which has given rise only too many terrible tales in the present nd last centuries. Their unique value as a fe place for the deportation of heinous ffenders against law and order was an after- ought, as it were.

I will now turn from this point, which I ope it will be admitted is of general in- rest, to the main object of the paper his is to give a general description of the lands, such as can be picked up in rapid ours round them. Just such tours as it will e my duty to make, as soon as I return in, ay, February and March next. But before invite you to go round with me and view, imagination, the every-day scenes to be btained from the Government steamer, on oard which we must now suppose ourselves be, I am obliged to give that much pre- minary information of a geographical, his- rical, and ethnographical kind as is neces- ary to your right apprehension of what is be shown you.

The European knowledge of the islands in e Bay of Bengal is a very old story, as d as our knowledge of the Bay itself. tsing, the famous Buddhist traveller, de- ribes the Nicobars in easily recognisable rms as Lojēn-Kuo, or the Country of the aked People, which he visited in 672 A.D. he Andamans are heard of in the Arab *elations*, under the name Andāmān, in 851, nd both the Andaman and Nicobar Islands e mentioned in the great Tanjore inscrip- ons about 1050, the latter as Nakkavāram. arco Polo, in 1293, describes both the ndamans and Nicobars under the names Angamanain and Nicouveram. And from at time onwards to the days of Archibald lair's survey in the last century, notices them are numerous and of course often ery incorrect, but in essentials the accounts ubstantially report the facts regarding them they are at the present day. All the aps, even the earliest, mark them with fficient accuracy to show how largely the dangers they created for the old navigators loomed in the eyes of even the earliest adventurers into these parts. So that to the world of geographical and nautical experts and students, the islands and their story have all along been well known. The varia- tions and changes in nomenclature have been surprisingly small, and in Blair's, which may be looked upon as the first authoritative charts, the majority of the existing place names were already established.

In 1789 a Settlement of the ordinary sort was effected at the Andamans, at Port Blair, in the South Andamans, primarily to put a stop to piracy. To this convicts were after- wards sent as an experiment, and it was subsequently removed to Port Cornwallis, in the North Andaman, as a political move; but in 1796 it was abandoned owing to the un- healthiness of the latter place. In 1858 Port Blair was again tried as a Settlement to put a stop to a dangerous recrudescence of piracy in the Andamans, a large number of convicts being introduced, who were chiefly mutineers, deserters, and rebels, after the Mutiny of 1857. This time the Settlement was fairly established, and steps are now being taken to render its future assured.

In the last and earlier half of this century, Danish, Austrian (*i.e.*, Moravian), French, and even Italian missionaries established temporary posts in the Nicobars, abandoned eventually owing to the unhealthiness of the islands for Europeans, and in 1869 we ourselves established for 19 years a Convict Settlement and military station in Nancowry Harbour in order to put down piracy and wrecking, an object which has been effectively accomplished. Since the withdrawal of the Settlement a firm grip has been kept over the islands and their in- habitants, which, of course, will now never be relaxed.

The indigenous inhabitants of the two groups, *i.e.*, of the Andamans and the Nicobars, are as different as can well be imagined, and have at no time had any con- nection with each other; and I may here mention that generally the geological struc- ture, the fauna, and the flora of the two groups are also quite separate, belonging, as I said before, the Andamans to Burma and the continent, the Nicobars to the great Malayan Archipelago, of which Sumatra forms a part. Mankind has followed the natural geological structure of the islands, and the Nicobars are inhabited by a variety of the Malay race, speaking dialects of the general Malay

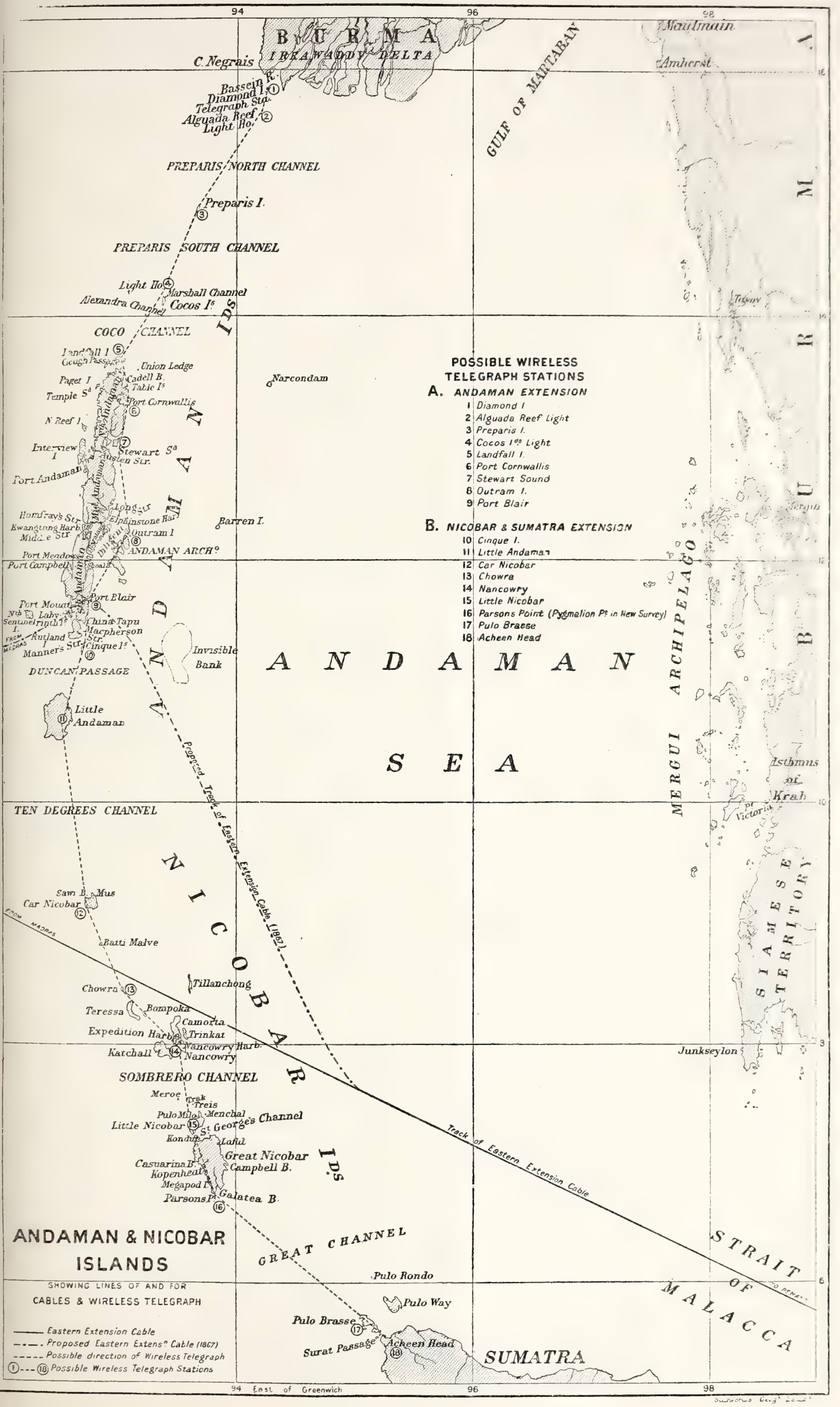
language. They are a fine, large, well-developed people, living in well-built orderly villages, under recognised chiefs and recognised customs amounting almost to formal laws. They are possessed of many rough comforts with decided ideas as to personal rights in the land and its adjuncts, rearing pigs and poultry, cultivating vegetables and fruits, but not cereals, and supplying their wants as to farinaceous food, clothing, and luxuries, from time immemorial, by an extensive and well defined trade in their staple product—the cocoanut. Though they are entirely illiterate, they are good handicraftsmen, and are possessed of considerable pictorial feeling. Their manners are jovial; their religion a so far irreclaimable animism, the missionary attacks upon which have passed off without even leaving a sign; their linguistic capacity is quite surprising, their own and other dialects of Malay, and then after a fashion English, Hindustani, Tamil, Burmese and Chinese being often spoken by the same man, every man of any importance being polyglot. They are abundantly lazy, peaceable by nature and not cruel, though some of them were sufficiently apt pupils of outsiders from the Malay Archipelago and Chinese junks to become pirates and inveterate wreckers until repressed. They are exceedingly comic in their behaviour, and a day at the Nicobars will afford a better day's fun to the well-intentioned stranger than in most other parts of the world.

The contrast between the almost semi-civilised people just described and the aboriginal Nigrito savages of the Andamans is complete. There we are face to face with the belated relics of a bygone time: naked coal-black, tuft-haired pigmies of a physiologically isolated group, unable to count. They are divided into some nine or ten connected tribes speaking mutually-unintelligible and continually-changing dialects of an isolated tongue, like each other, but like nothing else in the world as it now is. They live in temporary communal huts in groups, it is true, under chiefs, but with ill-developed social customs, and without any settled home or habitation, on pigs when they can catch them, turtle, fish and shell-fish, on roots and nearly every fruit that grows wild, without any ideas of cultivation or barter at all, and practically none of individual property. They have the bright but limited intelligence and the irresponsible ways of children, and can be taught about as much as one can teach the still adolescent child of civilised parents. Like children—quick of temper, entirely irresponsible in their wrath and equally quick to forget, lively in their movements, and exceedingly taking in their moments of good temper: like true savages—blindly suspicious of, and therefore dangerous to, all strangers, only to be tamed after the manner of all wild animals, with patience and kindness. Forty years of a policy of untiring conciliation, put into practice first by the late Mr. Homfray, and then successively, with so much credit, by Mr. E. H. Man, C.I.E., and Mr. M. V. Portman, has brought the vast majority of the people to treat us with entire confidence and trust; but it still leaves unreclaimed a tribe in the hills of the inland of the South Andaman and parts of Rutland Island, and in the North Sentinel—a tribe which slays every stranger, however inoffensive, on sight, whether a forgotten member of itself, of another Andamanese tribe, or a complete foreigner.

I will now draw your attention to the geography of the two tours which I will ask you to take with me round the islands, and though you will be helped on your way by means of many scenes of Andaman and Nicobar life thrown on the screen, from plates taken on the spot by Messrs. Man and Portman, often under great difficulties, I am unfortunately unable to do justice to the always beautiful and sometimes exquisite scenery of these islands. Still, I hope to be able to show you much that will be interesting, and some things that will perhaps be instructive and new to you.

On the first trip the start will be made from the anchorage off Ross Island at the entrance of Port Blair Harbour, and the voyage will proceed, with many halts, northwards through Diligent Strait to the end of the North Andaman, and thence through the swirling and rocky Cleugh Passage between it and Landfall Island to the west coast, down which it will proceed by degreee on the inside of Interview Island to Port Campbell, whence an excursion will be made to the North Sentinel to look up the intractable savages there, returning thence for Port Mouat and a run inside the Labyrinth and through Macpherson's Strait, past Chiria Tapu, home to Port Blair.

On the second trip we will leave Port Blair Harbour by the south entrance direct for that wonder of the sea, the volcano known as Barren Island, and thence straight to Car Nicobar, thence *viâ* Chowra down through Teressa and Bompoka and past Katchall to the truly lovely entrance at the western end of Nancowry Harbour. The ship will then


ANDAMAN & NICOBAR ISLANDS
SHOWING LINES OF AND FOR CABLES & WIRELESS TELEGRAPH
Eastern Extension Cable
Proposed Eastern Extens^n Cable (1867)
Possible direction of Wireless Telegraph
① --- ⑱ Possible Wireless Telegraph Stations
POSSIBLE WIRELESS TELEGRAPH STATIONS
A. ANDAMAN EXTENSION
1 Diamond I
2 Alguada Reef Light
3 Preparis I.
4 Cocos I^ds Light
5 Landfall I.
6 Port Cornwallis
7 Stewart Sound
8 Outram I.
9 Port Blair
B. NICOBAR & SUMATRA EXTENSION
10 Cinque I.
11 Little Andaman
12 Car Nicobar
13 Chowra
14 Nancowry
15 Little Nicobar
16 Parsons Point (Pygmalion P^t in New Survey)
17 Pulo Brasse
18 Acheen Head
BURMA
IRRAWADDY DELTA
C. Negrais
Bassein R.
Diamond I.
Telegraph Sta.
Alguada Reef Light Ho.
GULF OF MARTABAN
Maulmain
Amherst
PREPARIS NORTH CHANNEL
Preparis I.
PREPARIS SOUTH CHANNEL
Light Ho.
Marshall Channel
Alexandra Channel
Cocos I^s
COCO CHANNEL
Landfall I
Union Ledge
Cadell B.
Table I^s
Paget I
Temple S^d
Port Cornwallis
N. Reef I.
Narcondam
Interview I
Stewart S^d
Austen Str.
Port Andaman
Long I^s
Elphinstone Har.
Homfray's Str.
Kwangtung Harb.
Middle Str.
Outram I
ANDAMAN ARCH^o
Barren I.
Port Campbell
Port Mendow
Port Mouat
Port Blair
Labyrinth I^s
China Tapu
Macpherson Str.
Rutland I.
Manners Str.
Cinque I^s
DUNCAN PASSAGE
Invisible Bank
Little Andaman
ANDAMAN IDS.
ANDAMAN SEA
MERGUI ARCHIPELAGO
Tavoy
Isthmus of Krah
P^t Victoria
SIAMESE TERRITORY
Junkseylon
BURMA
TEN DEGREES CHANNEL
Proposed Track of Eastern Extension Cable (1867)
Sawi B.
Mus
Car Nicobar
Batti Malve
NICOBAR IDS.
Chowra
Tillanchong
Teressa
Bompoka
Camorta
Trinkat
Expedition Harb.
Katchall
Nancowry Harb.
Nancowry
SOMBRERO CHANNEL
Meroe
Trak
Treis
Pulo Milo
Menchal
Little Nicobar
St George's Channel
Kondul
Lafül
Great Nicobar
Casuarina B.
Campbell B.
Kopenheat
Megapod I.
Parsons P^t
Galatea B.
Track of Eastern Extension Cable
GREAT CHANNEL
STRAIT OF MALACCA
Pulo Rondo
Pulo Way
Pulo Brasse
Surat Passage
Acheen Head
SUMATRA
From Madras
To Penang
East of Greenwich

pass southwards to the west coast of the Great Nicobar round Parsons Point, the southernmost extremity of the Indian Empire, up the east coast and past Menchal, Nancowry, Trinkat, and the curious Tilanchong again to Car Nicobar, and thence past the Little Andaman and the Cinque Islands, home to Port Blair.

I must now point to you the halting places of the first tour. Starting from Port Blair, the first day out, the run will be past the entrance to Shoal Bay and Kyd Island, the entrance to Port Meadows and to the Middle Strait, through which large launches, drawing up to 7 feet, can pass, to the west coast to our first anchorage at Colebrooke Passage. Sending the ship round by Diligent Strait to Elphinstone Harbour, the party will proceed thither by the inland passage in the accompanying launch, past Wota-Emi, the most ancient known village site of the aborigines, and after a peep at the splendid Homfray's Strait, the voyage will proceed to the second anchorage in Stewart Sound, passing *en route* Pulugala-kabang, The Mouth of God, one of the homes of that curious swift that builds the edible nest so prized by the Chinese. On the third day, passing out of the narrow north entrance, the ship will proceed up the coast to Port Cornwallis, where a glimpse will be had at the remains of the old settlement. But there is a prejudice against staying the night there, and so the evening will be spent in Cadell Bay, nowadays fortunately a safe operation, because of the now thoroughly surveyed dangers about the Union Ledge. On the fourth day arrangements will be made to try conclusions with Cleugh Passage at midday, so as to secure a night's shelter in the newly-established Temple Sound. On the fifth day a run will be made down the west coast so as to go inside North Reef Island, where there is a comfortable anchorage, and through the very narrow Interview Passage and Port Andaman to the almost land-locked Kwangtung Harbour. The sixth day the voyage will be down to Port Campbell, very close to the Convict Settlement. On the seventh day the North Sentinel will be visited, and a run back made to Port Mouat, which is in the Penal Settlement. Running out thence through the Labyrinth and the fine Macpherson Strait by ship and launch, Port Blair will be reached *viâ* Ranguchang and South Corbyn's Cove.

As we are going round the islands on paper only, we are at liberty to play tricks with our seasons, and so I will imagine the voyage along the east coast northwards to be tak during the stormy south-west monsoon, a that along the west coast in the north-ea monsoon in fine weather. As a matter fact, no one except under compulsion wou visit so storm-bound a coast as the west aspe of the Andamans while the south-west monso is blowing.

The start from the Government buoy c Ross Jetty is made on a typical monsoo morning: a fresh, blustering, unsteady wi from the south-west, a troubled but not rough harbour, the most brilliant but fitf sunshine, racing clouds of varying size a density, splendid Turneresque effects on hil side and sea, for Port Blair is complete hedged in with hills from 1,200 feet downwar in height, and every now and then a gloom darkness, followed by hard rain squalls fro the west, and even north of west, whos blinding fury has, I think, to be experience to be quite appreciated. However, at th time for the start the sky is clear, the bar meter indicates nothing dangerous in the nea future, and the course will keep us in lee of th islands, and so the start is made. Port Bla Harbour lies before us in all its beauty. Th sunshine, the lively restless many-coloure sea, bare bright green Mount Haughton, an the great battlemented cellular jail, stretchin its irregular arms over Atalanta Point to th left, the blue and misty hills of the Cholung Range in front, the finely-wooded and much varied slopes of Mount Harriet to the righ front, with the palms, trees, and buildings c Chatham Island sharply defined in the fore ground, form together a picture which neve tires the eye. Passing gently onwards, an keeping pretty and prosperous Ross Islan on the right, we first pass the handsom European barracks at its north extremit built of local dark grey sandstone by convic labour under the supervision of Royal Engi neers. We proceed onwards towards Moun Harriet, from the top of which is a famou view from sea to sea over the Harbour. A seen in all the glory of a monsoon sunset i is a view to be remembered. That portio shown on the screen looks south over th inner harbour of Port Blair on to Viper Island It affords a strong instance of the contras sometimes observable between man and hi homes, for it is on Viper Island, so beautifu in its outward aspect and surroundings, tha the very worst of the naturally-wicked, th most depraved and intractable of the lif convicts are confined. This view is of genera

erest, for it is the very last on which rested eyes of Lord Mayo, the Viceroy of India, o of his great heart had done so very much ameliorate the condition of the convict, l was murdered by one of them on reaching foot of Mount Harriet. Briefly, the story this. After visiting the convict station on top of Mount Harriet, Lord Mayo reached bottom of the hill in the dark in circum- nces which cast no blame on the local icials, where the murderer, Sher Ali, was hiding, and as Lord Mayo stepped on the ty to return finally on board the ship that s to take him to Calcutta the murderer ang upon him and fatally stabbed him. was thus slain at the last possible moment attack. The scene on the screen shows site of the murder from a sketch made by ajor Jervois at the time and on the spot.

Sher Ali, whose portrait I now show, taken er the murder, was an Afridi soldier in itish service, and was in fact the victim the inevitable conflict between Eastern and estern customs as to right and wrong and punishment for wrong-doing. He had mmitted a murder in British territory, in rsuance of a family blood feud, and had en sentenced to transportation to the Anda- ıns. His subsequent murder of the Viceroy s purely an act of uncivilised vengeance.

Now, though the start had been made in ght sunshine, the experienced amongst us ve been well aware that the indications to south-west and west showed a rapidly proaching squall, and sure enough before have rounded the buoys of the north trance all is dark and gloomy. The course t of the harbour is barely set before the ıall is down on us. In an instant the land- ıpe is blotted out. The attention is absorbed the blinding hurtling deluge. Rain so thick ıt it acts like a fog on the vision; so heavy ıt its splattering flattens out the sea and vers it with thin eddying foam. The awnings soaked in a moment, the roof is bulged in, ter drips and runs down everywhere, and st and fine rain blow in at every opening. abs are wanted at once all over the decks. ere is the hum and buzz and straining of the ging, the loud flapping of everything that is se, and a cant over to leeward of the ship. rhaps a bright flash or two of lightning and crash of tropical thunder, but there is no ling or knocking about for the squall has me up astern and on the quarter, and so the p steams quietly and steadily along. In e course all the hubbub of the elements is over, the sun is out again, the side awnings are rolled, the decks cleaned up, and we find our- selves off the opening of Shoal Bay, some 20 miles from Port Blair. To the right lies the Andaman Archipelago, the scene in 1844 of the simultaneous wrecks during a cyclone, within a short distance of each other, of two trans- ports, with troops for Calcutta on board, hailing from such widely separated ports as Sydney and Gravesend. I wish I had time to tell you the story of the wrecks of the *Briton* and *Runnymede*, for it affords a fine instance of the pluck, endurance, discipline, and re- source under apparently overwhelming diffi- culties, which has distinguished British sailors and soldiers from all time.

Off Shoal Bay we anchor awhile, and tumb- ling over the bar in a cutter we land on Kyd Island — so named after Blair's successor in the abortive attempt of the last century, to look at the station placed there to watch for runaways from Port Blair. We also examine for awhile the process of building one of their large canoes by the Andamanese. In these dugouts made with the adze from the trunks of fallen trees the natives cross over from island to island, and wander all over the creeks, harbours, and estuaries. The canoes take a long time to build, hold a large crew and goods as well.

We then take a peep at the long narrow inlet of Shoal Bay, just now a veritable funnel for a rushing wind. It runs with a deep channel behind the Mount Harriet Range right into the Penal Settlement, affording a valuable means for transporting the good timber abounding on its shores, and then we return to the ship.

Once more on board we pass by Port Meadows, a safe but marshy and unhealthy harbour, still to be entered by Blair's most excellent chart more than 100 years old, and are shown the nasty rocks in the very centre of the passage in. Next, after seeing the site of the Reclaimer Rocks, found, as so many pinnacle rocks hidden under the sea have been found, by the sure process of running a valuable vessel thereon, we pass the entrance of the Middle Strait, through which may be made in the large launch that accompanies us a most interesting journey to Kwangtung Har- bour on the west coast, and thence through the beautiful Homfray's Strait, further north, back to Elphinstone Harbour on the east coast. We now steer direct for Strait Island in Diligent Strait, and just on reaching it turn sharply westwards past a jutting surf-covered

coral-reef, and with a roll or two find ourselves in the small harbour perfectly snug in all weathers, known as Colebrooke Passage, where we anchor for the night. In the evening when the wind drops, after its usual wont, about sunrise and sunset, a small party lands at the well-known Andamanese village site in this quiet, silent harbour, the ladies especially being carried ashore over the coral and sand for some distance in a boat chair on the shoulders of some of the sturdy little Andamanese, who always accompany these expeditions from Port Blair. If they are in luck the shelters doing duty for huts will be found to be up and the inhabitants to be enjoying the evening calm, stretched about the mangrove roots along the shore, very like monkeys in appearance. Should any of them happen to have been somewhat recently bereaved of a relative, he will be found to be wearing the skull and a chaplet of the broken ribs of the departed, by way of mourning, after the fashion shown on the screen.

It comes on to blow and rain again in the night, but storms do not trouble us in Colebrooke Passage, and we are up betimes next morning for a long day out. The ship is sent round through Diligent Strait to Elphinstone Harbour, which has been surveyed and charted in my own time by the capable officers of the Royal Indian Marine, and I well remember the preliminary days spent in the launches, which decided once for all the safe run in. The passengers, however, get on to the launch and run up through an inland creek, which makes the "passage" narrow, but safe enough save for one dangerous bit of rock well known to the old hands, and stop to have a look at Wota-Emi in a quiet bay in Elphinstone Harbour. Here is a lofty Kitchen-midden, on whose top the Andamanese still erect their shelters at times and add to the heap of shells which compose it. It is their ancient site, the traditional home of the people. We run into the entrance of Homfray Strait, and observe the lovely tangle of a truly tropical jungle on the lofty hills on either bank and have some conversation, at least our own Andamanese do, with some of the local visitors. These are sent away happy with tobacco, sugar, rice, and other things they value, and there is a small tussle. Some of our party want to stay with the visitors, and some of them want to join us. This little matter settled, the news is collected, for the Andamanese have news like their superiors in civilisation. It always comes out in jerks and quite inadvertently. Riala is sick and Wologa is dead, Ketia and Bira ha had a quarrel over a piece of pork, and Ke has run away. This last item necessita inquiry, slow and patient inquiry, as to w Ketia ran away. It is usually because B died of arrow-bite or of an accident with adze. By slow degrees Ketia is subsequen caught and dealt with; never hanged, course; it would be impossible to hang so ir sponsible a savage. What our visitors lo like you can see upon the screen, where a shown five women and a man standing besi a hut in the Home maintained by the Gover ment at Port Blair, where any Andamane that like can stay and be fed gratis for as lo as they please.

Proceeding on board we steer straight t the North Button in Diligent Strait, and th turn northwards for Stewart Sound. The laun goes by the passage inside Long Island, a those that wish can go in her to feel what it like to voyage in shallow unsurveyed water to avoid rocks and points of coral by trustir to the sight and "knowledge of water," a to run for miles in slightly less water than t vessel draws.

Getting on board we find the decks are n yet dry from the early morning scrub as th should be, and sailors will tell you what th means. The wind is down and the sea smooth, but we are barely safe on our cour when down comes the straight deluge th experts expected. Such rain: you can s nothing at all and almost hear nothing b the hammer of the downpour, which smoot out all the sea as flat as a mill-pond. Wh near a shore, if you can you anchor; if n you go dead slow. An hour or so of th stops all progress, and we are hard put to to get into that magnificent harbour, Stewa Sound, before nightfall to a secure anchora in the landlocked arm of it known as Bac Bay, after the capable Commander of t Royal Indian Marine, who first charted a few years ago. At the south-end of th bay is the badly shoaled entrance to Aust Strait, which runs through to the west coa and I well remember being caught in one the fogging showers just described on a fa ing tide while coming out of the Strait in launch drawing about as much water there would be on the shoals. The state the tide demanded haste, but the rain pr vented a move, and we had an unpleasa time of it in consequence.

The evening proves clear, if unsettled, a the Andamanese declare the time favou

e for a fish hunt on the shore, so off we bundle on arrival for a lively hour with fish left among the coral and sand as tide runs out. The Andamanese are in state of excitement with bows and arrows l spears, and soon there is a turning over stones and rocks, and they are hard at with hands and weapons. In a very short ne about 100 edible fish of sorts are caught, eared and shot with arrows, and we return h the spoil, which includes many lampreys d various kinds of cray fish. The Anda-inese way of cooking fish is simple: a od fire is lighted on the spot, and the arcely dead fish is placed on the embers, rnt brown, and the flesh is torn off with teeth then and there. On the screen you e some Andamanese in the act of shoot-g fish at Port Campbell, with the North ntinel many miles off in the distance. They ve no fishing lines and hooks, but are very pert at shooting fish, even in sea-water ider the influence of the tide.

Next morning we pass up the harbour and it through the narrow northern entrance, hich is not a nice place for a nervous man its present partially surveyed condition, up e coast to the wide and safe Port Corn-allis, to the immediate south of which lies e Saddle Peak (3,000 feet), being the high-t elevation in the islands. The west and orth are, however, low and swampy, and to is day give the place an evil reputation for vers. Here we find repeated the familiar imes at Port Blair, Ross, and Chatham lands, and on the latter the scant remains the abandoned settlement, just a few broken ts of sea walls of bricks procured from urma and of the distinctive Burmese type. Ve mark the rendezvous of the fleet which ssembled here for the attack on Burma in 824, and pass quickly on our way: the ship und the coast marked dangerous on the iarts until the quite recent survey as far s Cadell Bay, and the exploring party in ie launch up a creek communicating with ie sea further north off the Turtle Islands. his creek requires some negotiating in laces where there are shoals, and then iere is an interesting run inside the Table slands up into Cadell Bay. The run is afe enough now, but I shuddered to see ie places we had previously been through iore than once in apparent safety, when the uthoritative charts were shown me.

In Cadell Bay we pass the night, and now I iust ask you to suppose that the season has changed, and that we are in the fine clear weather of the latter part of the north-east monsoon. In the morning we pass northwards towards Cleugh Passage, inside the dangerous Union Ledge, named after the little sea-going vessel that Blair built, at his own expense, in his precarious Settlement, with that skill and courage so characteristic of the brave pioneers of the good old days, and subsequently sold to the Government. Cleugh Passage is not a joy to mariners. There is a swirling, eddying, ripping tide, an uncomfortable collection of rocks in mid channel, and a suggestively uneven bottom. So we are careful to secure a good light for going through, and send the big launch and the ship's steam gig on ahead. In this way there is no real danger and we are soon through, and then run down on a lovely evening to Temple Sound, the newly-established and very useful anchorage on the west coast between Paget Island and the North Andaman.

To those of you who are unacquainted with marine surveying, and are in search of excitement, I can recommend a day in an unknown coral-bottomed inlet. I remember one such when taking, with Mr. Portman and a young officer of the Royal Indian Marine, and with the effective assistance, as regards the coast lines, of Colonel Hobday's fine topographical survey of the islands, a large launch for the first time through this now thoroughly surveyed place of refuge, to see if anything could be made of it, while the ship waited outside. The ever-present risk, the constant need for vigilance, accuracy, and resource, make the days of the marine surveyor very full ones, though spent indeed far from the madding crowd, and if the words of a landsman can be held to be of any weight in such a matter, I should like to express my appreciation here of the worth of our naval surveyors.

At Temple Sound we land to look at the sort of place the North Andamanese live in. You see it on the screen. The sea actually comes up at high tide to the leaves on the sand and almost laps into the huts, the tops of which are visible.

Next morning we pass Shark Island, called originally Snark Island by the surveyors as a joke, but altered for all time to Shark Island by the draughtsmen, and steam rapidly down the coast so as to keep inside North Reef Island, where there is a safe anchorage, once much frequented by the Survey on Sundays while marking out the dangerous shoals to the westward, and then we run through the very

narrow Interview Passage on to the doubtfully advantageous Port Andaman. Here it was that Blair first came in actual contact with the savages in not very successful interviews, which then and for long afterwards alternated between friendly advances and conflicts, sometimes sanguinary, with this suspicious and volatile people. Nowadays, however, all is peaceful, and we exchange friendly shouts with such Andamanese as we meet, and find some engaged in spearing fish in the sea itself in the manner shown on the screen. Thence we run on till we reach in the evening the narrow and beautiful entrance of Kwangtung Harbour. This we find on entering to be large, deep, safe and smooth in the roughest monsoon weather, though on the west coast. In Kwangtung Harbour is a large generally occupied Andamanese village, and from the temporary inhabitants thereof is selected for your view a fine typical head. Observe the roughness of the skin of the face, the forehead half shaven with bottle chips for razors, the matted hair in tufts, the net-work necklace with its pendants of dentalium shells.

Running down the coast next day we reach betimes the fine harbour of Port Campbell, with its uncertain and, therefore, unpleasant entrance, and are close to the Penal Settlement once more. The headland known as Montgomerie Point, so typical of the coast, and shown you on the screen, is a landmark for the entrance.

On our way down we experience the results of the relative power of the land and sea for conducting heat, which is clearly shown by the configuration of the Andaman Islands. During the calm dry weather at the end of the north-west monsoon, unfortunately so very short in duration, there is regularly a calm about sunrise and sunset, and a breeze off shore at night and on shore in the day all round the islands. This phenomenon is specially observable on the west coast, and there day and night the breeze blows fresh between 12 and 4. Going into Port Campbell broadside to the sea about 3 p.m. we find this out, for we have a real rolling time, while we slowly feel our way inwards into the unbuoyed channel.

The neighbourhood of Port Campbell is the usual seat of war at the Andamans. What generally happens is this. Burmese and other ticket-of-leave men are fond of trapping pigs in the jungle, and so are the Jarawas, the recalcitrant tribe already mentioned. The best hunting season is in the hot dry weather, about February and March, when the pigs make for the water holes, whither the Burmese follow them. So do occasionally the Jaraw and then suddenly arrows fly from out jungle darkness. Perchance someone is l and the hunters bolt home to the Settlem for assistance. The wounded are alw killed, and then the Jarawas decamp. Th seems to be no ulterior motive for their acti It is due to a mere unreasoning fear of stranger. We then organise an expedition trained Indian police and friendly Andaman to hunt for the Jarawas. Generally we cat some and bring them to the Settlement, wh we feed and keep them till they are thorougl home-sick, and then we load them up w presents and let them go. Up to date, ho ever, unfortunately their memories have be too short to overcome the distrust of t strangers who surround them. The incide of these campaigns are often amusing. T battles consist of an exchange of arrows a spears until some one is hit, and then it is over, as a matter of course. Once I recoll our party captured the enemy's camp wh the enemy were capturing ours. The ene got the best of it, because there was more lo in our camp than in theirs. All this of cour is because it is only Andamanese that c really follow Jarawas into their jungle haunts

Port Campbell is a great place for shark and as soon as the anchor is down and the is leisure the whole party, including the Indi sailors and police and the British soldiers, we always give a portion of the garrison a airing on these tours, are all busy fishing f sharks over the ship's side; the Indians wi great eagerness, for sharks' fins are an artic of commerce in Bombay, whence the sailo come. In a very short time the deck is ali with small flapping, snapping sharks of a sizes, from 40 lbs. downwards.

Next morning we start for the North Sentine of which I give a view on the screen, some 4 miles due west. It is a small square islan of coral formation, about 16 square miles i extent, with generally open *mahwa* fores very like Car Nicobar in size and soil. A round it there is a roaring surf all the yea round, but on the south side a clear landin is afforded to the skilled by running in betwee the lines of surf which there curls round tw small islets off each extremity of the mai island on that side. It is by nature a ba place to land on, and otherwise positively da gerous owing to its inhabitants, who murde all strangers at sight—a ship-wrecked cre few in number would meet with certain deat I once saw an instance of this. Learning

t as a tour had been organised, that some ıvicts had gone away from near Constance y on a bamboo raft, and knowing that if ·y were not carried away to the open ocean perish there miserably, they must land on North Sentinel, I made at once for that and. On landing, the remains of the raft re found, and on the beach the freshly ırdered bodies of the runaways. They had idently been upset in the surf on landing, d had then got on shore, where they had hted a fire, thus attracting the attention the savages. They had clearly been atcked at the fire, and had tried to run into e sea, having been killed close to the ıter's edge. On our approach the savages ıd made off in such haste that the signs of recent launch of a canoe were still to be en on the shore.

This tribe is quite intractable. I once had pes of coming to terms with them, for one their number, who had been accidentally ırried out to sea in a canoe, landed among nges of the Little Andaman, with whom he aternised and lived for some two years. aking this man with us, Mr. Portman and made a determined effort to get into comunication with his people, but they had forotten him, and when he went up to them ıot at him so that he refused to stay on the land.

Leaving the North Sentinel and its inhospitble population, we return direct to Port [ouat and civilisation, for it forms part of ıe Penal Settlement, passing out to sea the angerous Allen Patch off Tarmugli Island. he entrance is very narrow and the harbour snug as to make it a great temptation to ıe Royal naval officers to ask for a coaling ation there. Just inside, however, in the ıirway there was until lately the scaring otice on the charts, "Hellby Rock 2½ fm. .d.," which I may explain to the unitiated ıeans "position doubtful." After a very atient and careful search this pinnacle and nother were at last successfully located and mark on shore put up to show ships how to void them.

Here we stay the night, get letters, and eceive such news as the Penal Settlement ffords. Sometimes there is plenty of the ort we are accustomed to, but startling to ıe visitors, for the temper of the convicts, ıken individually, is truculent. The local borigines come off to visit their friends on oard, and among them we observe a woman arrying her infant. As you see upon the screen she has slung a slip of strong bark sash wise, from shoulder to hip, in which the child sits. The Andamanese are very fond of their children and sometimes literally overpet them and nurse them to death. Also by chance we observe an Andamanese drinking out of his natural cup, a nautilus shell, which he has adorned with a zig-zag pattern of red ochre and wax.

We begin the seventh and last day of the tour by a run by ship and launch in amongst the calm inland waters of the beautiful Labyrinth Islands, partly along the route once proposed for the Eastern Extension Company's cables. We land to examine the jungle, of which I now show you a sample. Words can hardly describe the impenetrable tangle that covers the Andamans wherever civilisation has not reached; a tangle so thick that beasts cannot live in it, and, for that matter, but few birds also. From the picture you will guess why it is that only Andamanese can penetrate it at all. We can also examine the haunt of the edible gelatinous nest-building swift on Malay Tapu, and the adventurous amongst us can try their hand at amateur marine surveying; the experience will be a lively one in these waters. Sportsmen can have an exciting and perhaps novel amusement, for being in these parts they will observe that very strong lines and heavy iron hooks, baited with white rags, have been run out astern of the ship and left there. Presently when running about 11 knots there will be a big splashing out astern, and a quick eager rush to the side of everybody not on duty on board to haul in the line, attached to which, in due course, will be brought on deck a great edible fish of the bonito type, some 30 or 40 lbs. in weight, quite inert, for it has been drowned by the hauling in.

We then enter the imposing Macpherson Strait, between the South Andaman and Rudland Island, and pass close enough to the live coral-reefs along its shores to observe their wonderful colouring. Getting a glimpse of the abortive station of Norman's Town, of which only an isolated clump of cocoanut palms now remain, we round a jutting point and find ourselves once more on the east coast with Chiria Tapu, the only naturally bare rocks in the island, on our left, and the Cinque Islands on our right. Rounding Chiria Tapu we take a look at Ranguchang, where there is a garden for growing vegetables for the convicts, and some of us run up a pretty creek of the nature of that shown on the screen. It is a familiar scene in the Penal Settlement, showing some

Andamanese punting an out-rigged canoe up a shallow stream and shooting fish therefrom.

Leaving Ranguchang we find ourselves in civilisation, and the scenery changes to alternating wooded hills and grass downs on which cattle are feeding, and amongst which stand the huts of prosperous villages, of which South Corbyn's Cove is a type, occupied by ex-convict settlers and ticket-of-leave men. Soon the church and spire and crowded buildings of Ross Island are in sight, and we once more find ourselves among the shipping in Port Blair Harbour. In the foreground of the picture on the screen are some bad characters among the convicts in light chains hauling in a log for boat-building with their guard of petty officers, all also convicts.

I will now presume that a few days are spent in disposing of arrears of current work, for you must not suppose that life in the Andamans is all holiday, because in our journeyings together I have not burdened you with the business that occupies the officers' attention during each day out on tour. Business on shore being settled, orders are given to start for the Nicobars. This time we must be supposed to have selected the calmest and steadiest weather we can find in the north-east monsoon, and the journey will be mostly a very hot one. But, first, I must run over a few geographical details.

Starting from Port Blair a run is made out eastwards to Barren Island, and thence straight to Sawi Bay, in Car Nicobar, so as to arrive there on the second morning out, a good deal of night travelling being done during this trip. From Sawi Bay another night journey is made past Batti Malve to Hiwa Village in Chowra, and thence on the third day out between Teressa and Bompoka, calling respectively at the villages of Bengala and Pohat. On the same day a call is made at Dring Harbour, and running past Mount Edgecumbe and the entrance to Expedition Harbour, with Katchall to the right, we run into the very fine western entrance of Nancowry Harbour, formed, you see, by the configuration of the three islands of Nancowry, Camorta, and Trinkat. Here we must stay two nights and a day to explore and give the crew a little rest: to look round the harbour and its villages and the abandoned settlement. On the fifth morning, going out by the same western entrance, we will run across the Sombrero Channel past the curious islands of Trak and Treis to Pulo Milo in Little Nicobar, and thence past the eastern aspect of Kondul to a spot off Casuarina Bay, whence can be seen the entrance to the Alexandra River and the village of Kopenheät. Next morning will see us in Galatea Bay to explore the lovely river of that name, and on the sixth day there will be a run round the island on its western side, past Campbell Bay to Laful, where the party will again land and have a peep at the inland scenery in the Great Nicobar. On the seventh day we shall run up to Menchal off the east coast of the Little Nicobar, catching a glimpse of Ganges Harbour en route. Leaving Menchal we will look in at Kabila, Captain Johnson's village on Nancowry, and passing outside Trinkat and Mashöit on Camorta, an anchorage for the night will be found in Castle Bay in Tillanchong. The next day will find us off Mus to the east of Car Nicobar, and weighing anchor the same night we shall find ourselves off the Little Andaman in the morning and running up Duncan Channel inside the Cinque Islands through Manners Strait, and thence by the former route we shall arrive once again at Port Blair on the evening of the ninth day out.

This time the start is made out of the narrow south entrance of Port Blair Harbour on an evening of perfect calm, an oily sea beneath us and a clear bright sky overhead. There is no hurry, for the object is to reach Barren Island, only 75 miles off, by morning, but it is only in the calmest weather that a landing can be effected thereon.

Barren Island, *quá* island, is the summit of an ancient crater, some two miles in diameter, rising 1,000 feet out of a comparatively deep sea. The top has in some prehistoric convulsion disappeared, leaving a wide circle of hills open to the north-west only, where the lava found its way through to the sea. There is practically no anchorage, and the ship circles about in the offing while a party lands. The circle of hills, inside and out, is beautifully covered over with trees of many varieties of foliage, and the interest of the place is that in the midst of all this there rises a newer cone about 1,000 feet high. Perhaps there is no spot on earth so unique in its contrast of scenery; of sea, of verdure covered hill, of lava waste and bare cone. A hundred years ago Blair found the new cone active. At the present it is merely sulphurous and hot at the top, and there is a boiling spring at the landing. It is a long climb up and a quick run, or rather scuffling scramble, down in company with many ashes. The inhabitants are goats imported some years ago from the Andamans, and it will be

eresting to see if in time the breed will come a distinct one, as the Andaman pig s become, and as the Andaman crow im- rted from India or Burma is already said to . The sister island of Narcondam, further rth, differs altogether, and is a volcanic ne some 2,000 feet high, covered with lendid forest. Deep anchorages are to be ind off it, and it possesses one unique bird, e Narcondam hornbill, which can, however, easily shot by collectors. Spending a lazy renoon at Barren Island, and taking the nperature of the cone-top and of the iling springs for meteorological purposes, make for Sawi Bay in Car Nicobar, which reached by daybreak.

Sawi Bay is a small somewhat open bay to e north-west of Car Nicobar, affording a od anchorage in the north-east monsoon. ne surroundings are as different as possible om those of an Andamanese anchorage. n almost flat coral island covered with cocoa- its and typically tropical, and nestling among e trees to the south can be seen Sawi Village th its large conical houses on piles and its gzag garden fences. Long before the steamer n anchor outrigged canoes start out from all rts of nooks and crannies along the shore, d from Sawi: some are paddled, some are nder white lateen sails, some under the culiar stiff sails of the Nicobars made of ipped leaves of the cocoanut stuck upright the thwarts of the canoes; all are crowded. s they approach near enough to shout elcome in various languages, a truly won- rous variety of costume is revealed. There disreputable old Friend of England in an ncient black silk hat and a red blanket worn ke a toga, Offandi of Mus in a naval straw at and blue cotton suit turned up with red, ere is big Young Gwyn of Kenmai in almost othing at all, Captain Distant of Sawi in a owler hat and smart cutaway tweed suit, am Weller in a good French naval seaman's niform. There are Corney Grain of Kenuaka nd Tom Dixon of Harong, clothed as ecomes chiefs, while Lady Killer and Sweet Iary and Trilby in all their unkempt naked- ess gape and grin at us, showing their ideous black betel and lime-encrusted teeth. ittle Mary and Trilby by the way are men, nd this fact makes me note that the Nicobarese ll have vernacular names, but love an English ne if they can get it. Any sort of name will o if it sounds English. "I want good name" s the constant request from the self-respecting Nicobarese to the European stranger. "O well, try Trilby," is the answer. "T u r p i T u r p i—that good name?" "Yes, very good name;" and Turpi the man is for ever after- wards. I know a case where a baby boy was solemnly christened with treacle by request and named Sweet Marie.

Round they all come but not boisterously, and commence an immediate barter with the crew in cocoanuts and fish and fruit of many sorts, fowls and squeaking little sucking-pigs slung by the feet to bamboos, taking in return various odds and ends in clothing and food, ships' biscuits and hard stale bread being much in request. It matters not at all if these fall into the sea, for dry bread and sea-water make a good mixture for the Nicobarese palate.

Meanwhile the chief men are up on deck. "What news, Offandi?" "No news. Say, where's Man? Not see." This is his truly democratic Nicobarese way of asking for Mr. Man, the much-respected friend and judge of all these people. And then confidentially, "Got rum? I not well. I tight this day. I three sheets wind. I half seas over." This is unfortunately the truth. Commissariat rum is, I should say here, the panacea for all bodily ills in the Nicobars. The chiefs will get drunk on it, but to the people it is their treasured medicine to be taken in driblets only. Wily Friend of England is gone after it already. He will get none from the officials, who know his proclivities, but while strangers are on board there is hope. There is something on Capt. Distant's mind, and by and by he blurts out, "Hika gone jungle." There is a dead silence. Nobody speaks for a moment, but the officials prick their ears, and then Offandi mutters "He obtuse." He is proud of this, for he has shown off a new word. Young Gwyn grins and says "Got devil." The sequel is a long conversation with Mr. Solomon, to whom I must now introduce you, and the leaving on shore of a trusty official and some dozen police for reasons I will explain. The chiefs are told that we are going on shore at once, on which every one makes off to prepare to receive us, leaving Mr. Solomon behind, who has come on board on hearing of the arrival of the steamer. Mr. Solomon is an elderly native Christian from Madras, once in Government service, which he long since resigned to follow his natural bent of Evangeliser. He has been many years at Port Blair, but of late he has been established at Car Nicobar as an unofficial Government agent, meteorological reporter, and missionary. A school and residence have been built for

him at Mus. He is imbued with an untiring enthusiasm resting on a foundation of much common sense, and by the exercise of these qualities he has acquired a remarkable ascendency over the people used for their good. His reports form an invaluable series of anthropological remarks on the people from intimate knowledge at first hand. On this occasion he will be of great service in helping the police to trace out why Hika is in the jungle, for he has told us that, as we already suspected, he and another have committed not exactly a ritual, but what may be called an official, murder.

Just now interest centres in Sawi, and thither we repair in a very hot sun over a long coral reef. On landing we find a quantity of copra, the flesh of the cocoanut, drying in the sun, and belonging to an enterprising Burman, between whom and the Nicobarese there is a standing dispute as to payment and supply, all of which is poured into our ears by both sides, and finally the case is handed over to Mr. Solomon for report. Inside we find a typically clean and comparatively cool Nicobarese village in the midst of fine foliage, and there a group of Nicobarese greet us. There is Offandi in his official costume in the centre, and the late Davy Jones also, while some chiefs' relatives meet us, dressed in bowler hats only. The costume of the ordinary folk is limited, as you will perceive on the screen, to a very narrow loin-cloth, with the addition in the case of the young men of an ornamental head-dress. Their open mouths are the result of encrusting the teeth with lime and betel so much that it is difficult to keep the mouth closed. There is a woman also in the petticoat, which is the only garment of an ordinary Nicobarese female.

Presently are met a couple of *mafais* on their way to Chokchuachia. The *mafai* is a Car Nicobar institution; the term means a *coming shaman* or exorcist, styled in Car Nicobar a *melluana*. Both the *mafai* and *melluana* may be of either sex. Their occupation is exorcism, and their life is otherwise one of complete idleness. The profession lasts as long as they can explain away failures, this last being their real business in life, and they are consequently experts in excuses. The *mafai* commences by relating striking dreams, and completes his or her education by accompanying or watching *melluanas* at their exorcising performances. There are two to four *melluanas* and eight to ten *mafais* in each village. They are so loaded with silver rings round both calves and ankles and round the whole of each arm, with the addition of silver coin necklaces, that they cannot walk, and have to be carried to their work in chairs, as on the screen. Those of our party that are lusty and strong can follow the *mafais* to Chokchuachia and there inspect the cemetery. The path will be found to be clearly defined and shaded by cocoanuts and other trees.

On the screen is shown the cemetery and dying house at Chokchuachia village. The cemeteries are always on the seashore, and the house attached is that to which the dying are conveyed. There is also generally a lying-in "hospital" in the neighbourhood. The dead are temporarily buried in graves with the head-posts of the pattern shown. After a while the bones are exhumed and thrown into the neighbouring ossuary, in which finally rest pell mell all the village people, head-posts and all. I draw your attention to the extreme cleanliness and neatness with which all village sites in Car Nicobar are kept. They are not, as is usual in the East, evil-smelling places.

Resisting the pressing invitations of Mr. Solomon and Offandi to visit Mus, and presenting Capt. Distant with a new captain's suit as a mark of rank, we distribute the customary presents to the village, which must, by the way, include China tobacco, and as medicines Eno's Fruit Salt, turpentine, coarse castor oil and commissariat rum, doled out in small quantities into cocoanut shells for cups. We then return to the ship. I should explain that the term Captain is the highest idea of rank to the Nicobarese from observing the master of a trading vessel. All chiefs are "captains." The position of the Chief Commissioner rather puzzles them, as Offandi once explained: "I big man Mus; you big man Andaman. You and I same like. Queen big man England. You Queen's brother, I think."

In the small hours, while the passengers are still asleep, the ship weighs anchor and proceeds down to Chowra, anchoring off Hiwa at daybreak. The inhabitants of this island are a surly, sulky lot, the bullies of the Nicobars, and have had to be brought up with a round turn more than once. However, they possess three things which make them respected by all the Nicobarese; the powers of making pottery and big racing canoes, and a curious table hill, on which dwells a "very bad devil." They are on their best behaviour just now, and the Union Jack is flying. This is part of a chief's simple duties, to pay his respects to all official visitors, and to fly the

Union Jack given him for the purpose on the approach of all ships.

On landing for a very brief space we have an opportunity of observing some of the women making pots by hand. The pots are not turned on a wheel. On the screen is shown a group so employed, for this is only a woman's task on Chowra. Observe that the poorer women have skirts of split cocoanut leaves, while the old lady of the party has arrived at the point of purchasing a Malay sarong made in Europe.

Buying a derelict sanpan lost from some Chinese junk from the chief for a few bottles of rum, we drop quietly down to Teressa, warning having been given by some white lateen sailed canoes, which have put out for that purpose as soon as we were sighted. The anchorage on the inner and semicircular side of Teressa is bad, and so the ship lies off the shore as near as the coral reefs will allow off Bengala. It was on this island that the French missionaries, Chabord and Plaisant, were still living in 1842. We are soon boarded by the influential chief, Capt. Gibson, who had to be severely spoken to for again being drunk. This is not his usual condition, but on these occasions he has sometimes to walk far, and, fatigued by the heat, he has called at various houses *en route*, where, as in duty bound, he has been supplied with cocoanut arrack, with disastrous results.

Finding all well we run across to Bompoka, and anchor off Pohat, spying white-winged messengers skimming down towards the strait to give warning of our approach. There is one of the, as yet, unexplained festivals going on ashore. Not that there is anything lively. All is lazy and slow and unconcerned: but there are men sitting about painted a greasy scarlet all over their faces, with garlands of bright flowers and leaves round their heads. Their appearance is striking, if comic. The people are stupid and uncommunicative, for they have been up all night, and so we are soon off on board again to avoid a rattling thunderstorm that has gathered suddenly from the east behind the tall hill of Bompoka. However, it is soon over, and a start is made. The scenery and atmospheric conditions have now both changed. In this latitude smart heavy showers are more or less constant all the year round, though the violent storms and monsoons of the regions further north are rare. Indeed, round the Great Nicobar continuous fine weather is quite the exception, and plenty of quick variety in that respect may be looked for during a visit there. On the islands there are now considerable elevations, some covered with a dense jungle and palms, and some with a tall bright green grass, in which no forest seed can germinate. The effect from the sea is that of stretches of well-kept wood and meadow, reminding one generally of the hilly part of the coast of Great Britain.

The storm over, it is once again a lovely day, and the ship runs down rapidly between Teressa and Bompoka on a strong, swirling, eddying tide, and makes for the open land about Dring Harbour in Camorta. It cannot enter by reason of the coral reefs which have filled it, but the ship's launch is soon afloat and we are running in and out between the reefs of a circular bay, having only one entrance for Panoha Village. The inhabitants, not having seen the ship, are shy, and every woman has bolted into the jungle. Soon, however, they recognise the cries of some of their friends who have accompanied us, and the men who have remained behind come crowding round. Enquiries are made about the wild cattle, for it is from this spot that expeditions can be best organised for the only big game the islands afford; itself a relic for all one knows of the missionary enterprise of the last century. We do not stay long here, and after inspecting a beached and hopelessly injured derelict buoy of the Eastern Extension Cable, are once again running smartly down the west coast of Camorta past green and bare Mount Edgecumbe—so-called from its general resemblance to the scenery round Plymouth—with the dense dark foliage of Katchall to the right, an island with an evil reputation to the other Nicobarese, of distrusted surly inhabitants and queer mysterious caves. It is the only island of the Central Group on which monkeys abound.

The Camorta hills are now wooded to the water's edge, with here and there a village on the shore. In a short time is noted the obscure entrance to the narrow and many branching Expedition Harbour, a place unhealthy even to the natives, with an ugly comparatively recent story, never quite cleared up, of the horrible fate of the wife and servant of the wrecked European master of a small local trader. Almost immediately after this we look into the narrow western entrance to Nancowry Harbour, and turn sharply to go in.

I look upon this entrance as one of the things worth seeing, and I know of nothing of the kind more beautiful, especially if the sun be still in the east. The hills of Nancowry and Camorta are here forest-clad from sea to summit, and out of the forest and all along the ridges and points stand out against the sky

the lovely feather palms of the Nicobars, and splendid festoons of bamboos and canes and creepers of all sizes. In the shady places the bright broad bands of the plantain and huge ferns come out in vivid contrast to the dark forest depths behind them; and every now and then amid all this are the picturesque spindle-legged brown thatched beehive huts of the people.

Point after point of ever fresh beauty opens up as we pass Burleigh's Rock, named after a worthy past and gone ship-master, who is said to have been so impressed by it that he never used this entrance, but preferred the wider though more difficult eastern one. The ship is skilfully guided through the strong uncertain current of the tide in the narrow ways up the long fine harbour between Camorta and Nancowry. To the left is seen the typical Nicobarese village of Itoè belonging to Captain London, a fine big half-breed between a Seedy boy and a Nicobarese, who soon comes grinning on board with nautilus and other shells for sale, a reminiscence of the days of the Settlement. The portion of the village now shown on the screen is partly over the water, and built much on the same lines of the lake-dwellings of old. The familiar circular huts of the Nicobarese are to be seen on shore and even over the water. All the huts are on piles with walls of reeds and mats, thatched over with grass and cocoanut leaves. One of the circular huts is shown in the very slow process of construction, for the Nicobarese are really a lazy people. The second portion of the village thrown on the screen is that mainly over the tide-water, as is many a village in Burma and Malayland. Observe the primitive perches to show the line of deep water between the coral-reefs.

Presently we anchor off the jetty of the old Settlement. No one, except some Indian and Chinese traders, comes near us for some time, for it is dinner time, and who would expect a self-respecting Nicobarese to do business at such an hour? However, several Chinese junks and Indian schooners are in the harbour trading, and every one of these is boarded and examined for *samshu*, an abominable rice and sugar spirit, and for cheap guns. Both are equally detrimental to the peace of the islands and are contraband. While this is being done the traders we have brought with us are landed with their heterogeneous baggage, and some cows belonging to them are put overboard to swim ashore. One goes the wrong way and is unceremoniously caught by the head and towed in the right direction with such callous roughness that drowning seems inevitable. However, it lands all right, and immediately begins grazing. "Eating is always good" is a sentiment that Kipling has put into the mouth of this class of animal. The evening closes with some thunder and lightning and a little rain, and it is learnt from the Government agent that some Chinamen with guns and *samshu* are in the Great Nicobar, and that there has been a wreck off Tilanchong.

The next day is variously spent according to individual fancy. Some go shooting birds at Trinkat, some go fishing in the harbour and the strangers to examine the villages and sites of the missionary efforts of the last century and also the former British settlement—the remains of the fine roads, reservoirs, and wells, the jetty, the flagstaff, the sites of the former bungalows and barracks, the spot where the local resident official, Mr. de Roepstorff, was shot by one of his own guard, and the remains of the house where his plucky wife lived alone and carried on the business of the Government till communication could be had with the outer world, the poor little cemetery with its pair of lonely white men's graves—all pitifully overgrown with grass and creepers, through which the flowers of the Europeans' exotic gardens are still seeking the sun.

Crossing over the harbour the party lands at Malacca, the largest village in the place, and are received by gentle old Captain England, who complains of his advancing years and their accompaniment of rheumatic pains and stiffening joints, and asks after Christan, by whom he means Mrs. de Roepstorff, who was named Christian. While we are talking to him sharp female voices cry out from the darkness of his house. It seems that one of the party has touched with sacrilegious hands one of the curious erections set up outside it as a prophylactic charm against disease. Captain England explains that he must not do that, for it is a "very bad devil," thus confounding characteristically the evil and the protection against it. This causes us to climb up inside the house, and the first things we meet are ghastly wooden figures with glazed mother-o'-pearl eyes holding spears at our heads. These are the house guardians or *karëau*. One of them is selected for purchase, but Captain England will not sell at any price, much to his credit, not even for the two bottles of rum that in his opinion will surely drive away all his pains and rheumatism, for

the cure could then be spread over such a long time. He eyes the bottles sorrowfully and says: "No, not sell." The reason is that it is the guardian of his absent son Tannemara, which name by the way is a relic of the Danish missionary Rosen, who worked in the harbour up to 1836, and is meant to represent the Danish pronunciation of the national term Denmark.

The kind of thing to be found in and about a Nicobarese hut is shown on the screen. Above are cocoanut water-vessels. Then there are three *karëau* or spirit scarers, and on the table hats for exhumed female skulls previous to transfer to the ossuary, and two or three fighting helmets made of cloth or the husk of the cocoanut, for the Nicobarese are fond of playing with the quarter-staff. There are models of square and round huts and of out-rigged canoes, one with lateen sail and mast. Also a couple of planks pierced with mystical carving by order of a *melluana* for the benefit of some sick patient.

At the back of Malacca, round about a swamp, are the few remains of the Moravian Settlement of 1768-87; just a hedge, a well, and a brick foundation here and there. Looking at these, one cannot help regretting the useless waste of energies, the ignorance of practical affairs that induced intellectual enthusiasts to throw their lives away in such a place as this.

Returning to the ship it is found that the shooting party on Trinkat has not returned by nightfall, which causes some anxiety, as the evening has closed in darkly with a breeze from the east and much bright lightning. In the middle of dinner they turn up dirty and tired. It seems that they stayed too long and were still involved in the nasty reefs to the east of the island when darkness set in, and had been obliged to steam in the little launch cautiously and slowly almost all the way into Nancowry Harbour through a lumpy sea. As a matter of common sense it is not wise to run unnecessary risks in these only roughly explored waters.

Next morning we are off down the harbour betimes and see the splendid western entrance from the inside, and then run down between Nancowry and Katchall across the Sombrero Channel, so named centuries ago, past the islands of Trak and Treis in doubtful weather to Pulo Milo, a pretty little harbour midst the dark, densely clad, and really lofty hills of the Little Nicobar. Here snugly hidden out of passing sight is found a Chinese junk, whose master is neatly caught cheating and bullying the few timid natives of the place. This little matter settled, we proceed past Little Nicobar and the curious little island of Kondul in St. George's Channel, between the Little and Great Nicobar. On this is a well-known village, which, however, we cannot visit this voyage, and run on to the west coast of the Great Nicobar to the chosen anchorage south of Casuarina Bay in the road off Alexandra River and Kopenhëat.

Great Nicobar is an island of elevations reaching to 2,000 feet, covered from top to bottom and in every part with a dense and mighty forest. It boasts of two large navigable rivers, the Alexandra and the Galatea, each closed in unfortunately by an undeniably formidable bar. The views in these are singularly beautiful, and throughout the island there is everywhere one succession of scenes of topical grandeur.

Round about the higher elevations nearly every day gather storms and thunder clouds, and as in Singapore and similar places, there is rain on very many afternoons throughout the year. After passing Kondul we are treated to a typical afternoon squall, which effectually obliterates everything for a short time and obliges us to go slow for a while, but when it is over we spy two junks making all the sail they can out of the creeks about Kopenhëat. Their action causes suspicion as to their being the smuggling junks mentioned to us in Nancowry Harbour. The steamer gives chase at once, and in about an hour they are overhauled and drop sails and anchors. On boarding them it is discovered that a well-known old offender is once more made much disgusted with the bad bargain he has made out of his contraband goods.

After this little bit of excitement we find ourselves at anchor in a gently rolling sea, well within sound of the roar of the never-ceasing surf on Alexandra bar, and prepare to land at Kopenhëat Village, chiefly to find out what the villainous old Chinaman has been up to. The appearance of the village is shown upon the screen. Observe the plank walls of the houses, the clean floor of the village, and the comparatively good clothing of the inhabitants, the orchids encrusted on the palm stems, and the general rough comfort of the place.

The enquiries do not come to much, for the people are timid and lie like the timid all the world over. They are afraid of the Chinamen, but much more afraid of the Shom Pen, a wild

inland tribe of the hills. Between them and the coast people is an eternal feud, which brings about periodical wars. A war is in this wise. The Shom Pen come down from the hills suddenly, burn down a hut or two, kill somebody, but rarely more than one person at a time, loot all they can and depart. The looted village is at once deserted, but re-occupied after a time, when the coast people get up an expedition and retaliate in like fashion on the Shom Pen.

In the morning the ship sails on southwards past Megapod Island. Speaking unscientifically, the megapod is a largish fowl with large splay feet, and good to eat. It lays an outrageously big egg for its size, which it hatches by a process of its own. The nest consists of a heap of sand and refuse carefully raised on the shore, on which the eggs are laid and covered up. The sun does the hatching, the birds neither sitting on the eggs nor looking after their young. The megapod can run very fast and requires some shooting. For reasons of sport and game several unsuccessful efforts have been made to acclimatise the bird at the Andamans.

Leaving Megapod Island the ship rounds Parsons Point, the southernmost extremity of the Indian Empire, and anchors in the open Galatea Bay hard by. Through the 60 miles or so between Parson's Point and Acheen Head passes the great traffic between the Straits, China and Japan with the west. There is a whole day before us here, for we intend to make our way into the Galatea river, the surf on the bar thundering not far off in front of us. To the south are the charred remains of some huts and an entirely deserted village, evidence of a tolerably recent descent of the Shom Pen. By carefully going inside the coral reefs and rocks to the north of the bar and steering in behind them, we can get into the river with comparative ease and safety on a smooth day. On the screen is shown a typical bit of bank scenery in Galatea river with its tropical trees and shrubs, its canes and ferns and splendid tree ferns and pandanus. On the river is a Nicobarese outrigged canoe manned by four local natives.

Next morning the journey is continued past Campbell Bay to Laful, a pleasant anchorage in a south-west wind, but too open to the east and north-east to be altogether pleasant or safe. The great heights of the interior are seen to advantage hence, and the interior scenery is well worth a visit. There is an important village here, and the place is consequently frequently visited. On the scre is a typical bit of water scenery in the neig bourhood of Laful. The men on the stones a the Andamanese servants of Mr. Man.

Laful has a melancholy interest as the sce of a disaster some years ago, in which Capta Elton, of the Royal Indian Marine, lost his lif while trying to sail over the surf with a party ladies and others. They were upset, and h was sucked under by the surf and drowne As the already strong breeze freshened shore the half-drowned party had a rough tim of it in the Nicobarese huts for some day Mrs. de Roepstorff was one of them. Captai Elton's body was afterwards recovered an buried on the shore by the Nicobarese, bu unfortunately so close to high-water mark tha it causes some trouble to maintain this lonel grave, one of so very many such throughou the East.

In the night a strong disagreeable win springs up from the East, which makes ridin in the uneven-bottomed road anything bu pleasant, and the onward journey is made o as unpromising a morning as could be wishe away. A strong breeze, black lowering clouds a misty ruffled dirty green sea, squalls o driving rain. But we are off as soon as ma be from the inhospitable anchorage, and ru northwards for Menchal, just getting a peep at the once useful but now coral-reefed Ganges Harbour, where about 1750 there was a Danish settlement.

As we near Menchal the bad weather disappears all at once, being caused in fact by the swirl of a local storm off the summit of Mount Thuillier in Great Nicobar. A landing is effected on Menchal to note the great bamboos. On the screen is shown some of the palm scenery of the island: cocoanuts, three sorts of arecas, and the pandanus.

Then the ship proceeds direct to the east of Nancowry to visit wily old Captain Johnson's village of Kabila. We find the old sinner ready to sell anything any one will buy, from his family "devils" downwards. After a chat and a bargain he asks when we shall be back. "One moon after one moon" is the answer. This is contrary to experience, so Johnson remarks calmly, "That lie."

On the screen is shown Captain Johnson at home surrounded by his well-dressed family. Observe the walls of cocoanut spathe, and Mrs. Johnson seated in dignity on top of the house ladder, and Miss Johnson in full Malay costume. Captain Johnson himself is seated on the stool of honour, and a young gentleman

his family stands behind him with his hands his coat pockets. The other young bloods the house in a check shirt and naval cocked it are also worthy of our observation.

Leaving our blunt but withal jovial old iend, we run rapidly past the long low shores : Trinkat to the north of Camorta, where we ave off Mashöit a peep at the Beresford hannel between Trinkat and Camorta, so amed from the daring but somewhat wild feat f that commander of taking his vessel through s shallow and tortuous ways. Mashöit is the cene of several piracies in the days gone by nd of a remarkable occurrence in 1839, when ie people looted the whaler *Pilot* and killed ll its European crew of 40, except five who ut off to the open sea in a small boat, and by ccident met Sir Hugh Gough's expedition *n route* to China. The *Pilot* was recovered nd taken to Singapore, and the swift and stonishing punishment following on their act, ut of the blue as it where, is remembered by hese villagers to this day.

The ship soon reaches the long, narrow, urious and entirely uninhabited island of Tillanchong, a land of evil spirits to the Nicobarese. Oddly enough, though well overapping the Nicobar groups, it belongs to the Andaman series of ocean hill tops.

Noting the change in scenery and the bold liffs of this narrow ridge, we anchor in Castle Bay and spend the evening looking for the vreck mentioned to us by the agent at Nancowry. A plank or two, the keel and ribs of a small craft, odds and ends of iron-work such as belongs to sea-going vessels, are all hat remain to tell of, who knows, how much suffering in this lonely sea.

A long swell comes up from the south-east, and the weather is threatening and unsettled, and so a start is made for Car Nicobar betimes during the night. Most of the journey is not good for bad sailors, for though the decks are dry we nearly roll our boats in all night, and there is for a time a lively variety of motion, as we run through one of those violent tide-rips characteristic of these parts. There is a large one off the north of Car Nicobar, which affords samples in rough weather of every kind of motion that a ship is capable of.

However, as we approach the more regular seasons of Car Nicobar all this mostly disappears, and by the time we have sighted the great beacon off Mus and made out Offandi's Union Jack, it is calm enough for a rough and tumble landing on the surf-beaten shore. The police have captured the two murderers—Hika and Kinki—and bring them to us handcuffed. Their clothing shows them to belong to the upper-class of Nicobarese, and they are not nearly so villainous in character as they appear on the screen.

It appears that it was decided in village council at Lapati, strongly suspected to have been under the presidency of the headman thereof, that one Lowi was a thief, who did not live in the regular way. In fact he was a bad man and had a "devil," and so he was a danger to the community. Now, when a man has a "devil," there is only one thing to be done with him; he must be killed in the orthodox manner and his body put into a boat and cast into the sea. The orthodox manner is to break the limbs and then the neck. On this occasion the executioners were the prisoners acting on the public behalf. Their behaviour on trial is characteristic. A witness is discribing the scene when Hika calls out: "Not same like that! I take his head so. Make go back and his neck break!" Says Kinki to the judge disgusted with the length of the proceedings: "Say, Man, this very long. Give us cheroot."

It is quite impossible to get anything but a dim glimmer of a notion of wrong-doing in what was done into the heads of Hika and Kinki, or of any other Nicobarese for that matter. So they are detained in Port Blair until thoroughly home-sick and cowed, and until the relatives even of the murdered man beg for their return. They are then finally landed back again in full convict uniform, of which they are quite proud; and well they might be, for they are for a time among the best-dressed people on the island. It is quite odd to watch the air of unconcern and accustomed possession with which a Nicobarese released prisoner will shoulder his bundle and march off home on landing on his native shore. I may say that the Nicobarese dread dying away from home more than anything else, and so detention at the Andamans has real terrors for them, and by dint of arresting and detaining for a time every perpetrator of a customary murder, this peculiar sort of lynch law is being steadily put down.

Taking Hika and Kinki with us we are once more on board, but not before we have examined Mr. Solomon's school and house and observatory, for he is a meteorological reporter amongst other things, and he shows off his converts and pupils with pride. It is odd to see some of these people reading in English and repeating in English also correct Christian sentiments. But it all does good, and Mr.

Solomon's efforts to keep up peace and good-will between village and village are practical. For instance, he took advantage of the late Jubilee to bring together two villages at feud at a great feast held in honour of that distant Queen about whom they hear so much and understand so little. On our way back to the shore we are waylaid by Mrs. Bradlaugh, an old woman so named from a remarkable likeness to the well-known politician, and we espy a fattened pig, quite as large as an English prize pig and as fat, unable to walk. When he is quite fit for it there will be a big feast over him.

Our send off is characteristic. There is a crowd of boats doing a last bargain and containing all our friends, Offandi still half seas over and vainly endeavouring to put on a white suit just obtained over the dark one he already has on. Friend of England in his black silk hat and almost nothing else, his red toga having fallen off in his endeavours to stand up in a boat no bigger than himself, in order to offer a rupee for more rum. Young Gwyn newly adorned in a tall white hat tied round with a yellow puggaree striped with red and a newly acquired suit of white uniform. The coat and shirt he wears, but he has tied the trousers round his neck for convenience because these unaccustomed garments chafe him. Yet he salutes with all gravity as becomes his dignity as a young chief. Mr. Solomon quietly and gravely saluting as he paddles off to the shore. All are very friendly and respectful in their democratic way. Altogether it is an instructive sight, if comic, and ever fresh, this rough homage of a totally ignorant people to the far stretching arm of the British Empire.

By next morning we are off the low dim shores of the Little Andaman, and running up inside the pretty Cinque Islands, past Portman Harbour, in massive and imposing Rutland Island, past Manners Strait and the now familiar Chiria Tapu and South Corbyn's Cove, we once more enter Port Blair Harbour from the south. Here in front of us lies Chatham Island, with its saw-mills for converting the timber taken out of the forests both for domestic use and export. The work done here goes a long way towards reducing the cost of the convict to the taxpayer. Chatham Island was to have been the station in the abortive Eastern Extension Cable scheme, and may yet, for all we know, be a station in the future wireless telegraphy scheme, which all of us hope will before long be in operation.

DISCUSSION.

Major FLOOD PAGE said he was present by the invitation of Colonel Temple, who had asked him to come and say a few words with reference to the matter which he mentioned in the opening of his paper, namely, the use of wireless telegraphy in the Andaman Islands. Before referring to that, however, he should like to say a word on the paper itself, which had been given by a man who belonged to a class of whom England might well be proud—one of the military political officers of the Indian Empire. He felt quite sure from what he had heard and seen that Colonel Temple looked on the Andaman Islands and their inhabitants, and even the 12,000 or 13,000 convicts there, as if he were the father of them all. He had great pleasure in confirming what Colonel Temple had said, that there would be no difficulty whatever when the time came in establishing wireless telegraphy all round the islands. It was useless to discuss just now, how many stations there need be; he presumed the Indian Government would deal with wireless telegraphy as a whole, and it would be for Colonel Temple to try to convince that Government that it should be supplied to the Andaman Islands first. That would probably depend very much on the influence which the various shipping companies brought to bear on the Indian Government. On 28th December last, for the first time, wireless telegraphy was established between the shore and a lightship, and it has proved a very great success. In last June or July Marconi's system was established between England and France a distance of 32 miles. When the French Government had made them take down the apparatus at Wimmereaux the Belgians kindly offered a station at Ostend, but they had come to the conclusion that that kind offer was not of much use, because they were no longer interested in distances of only 70 miles, but thought no more of going that distance than of calling a hansom cab; in fact there was no interest in any problem as far as distance was concerned of less than 100 miles, and Colonel Temple was not at all too sanguine in saying that it would not be at all difficult when the Indian Government chose to do so to apply wireless telegraphy to the whole of the Andaman Islands.

The CHAIRMAN said if no one else desired to speak he would only add a few words before proposing a vote of thanks to Colonel Temple. From personal observation he could bear testimony to what had been said as to the beautiful scenery in that part of the world. In 1874 he was sent there by Lord Northbrook, to furnish a report on the Penal Settlement, and he found a very great contrast in the kind of life on landing with that which he had had at sea. It was very rough weather, and it was not a very big steamer, so that they did not have a very comfortable time, but when they got

:o Port Blair he soon found himself in a very mfortable house, with very old friends—Sir Donald :d Lady Stewart and their family. He went about great deal with General Stewart to visit different ›rtions of the Settlement, which gave him a good ›pportunity of seeing the scenery. He remembered particular one day's holiday, when Lady Stewart ıve a picnic on Rutland Island, which was attended y nearly the whole society of Port Blair, and Sir ›onald Stewart named the landing place Norman hât (he presumed in his honour), which he ıought was the place now called Norman Town by olonel Temple. He was not at all surprised that should not be a flourishing settlement, for he ›uld not conceive a worse place for a town. Colonel 'emple had said something about the savage nature f the people in Rutland Island, but he could only ıy they had a very pleasant picnic there. One of he islanders brought a pig they had just shot, which hey wanted the visitors to partake of, but the offer vas not accepted. It seemed to him that Port Blair vas a very pleasant place indeed to live at. There vas nice society, and a good convict band, and the ıead of the society, of course, was Lady Stewart. There were two great disadvantages there: one, hat the post only came once a month, and at one ime only once in six weeks, and there was no telegraph. He did not know whether any improvement ıad been made in the postal arrangements since, but t might be that at some day not very far distant, ıs suggested by Colonel Temple, they might have ·ither wireless or some other form of telegraphic :ommunication. He and others had urged strongly he necessity for it. He understood that estimates ıad been prepared, but as far as he made out he cost was found to be too heavy. It would :ertainly add greatly not only to meteorological knowledge but to the amenities of society in Port Blair and the Andamans if it was established. Another place named by Colonel Temple that he saw when on a voyage to China was Narcondam Island, a pinnacle rising to a height of 2,000 feet from the sea, which was as remarkable an object as he had ever seen in any part of the world. He would conclude by asking them all to join in a cordial vote of thanks to Colonel Temple with the wish that when he returned to Port Blair he might have health and every success in his administration, and he trusted that it would not be very long before he was removed to a more pleasant position on the Continent of India.

The vote of thanks having been carried,

Colonel TEMPLE, in reply, having thanked the Chairman for his kindness in coming to preside in the absence of Sir Henry Fowler, said he was rather sorry that none of the numerous commercial men present had spoken, but he presumed he must attribute it to the habitual caution of gentlemen in charge of very large interests. At any rate he thanked them for their attendance, and he also thanked Major Flood Page very much for his remarks, which strengthened him in the opinion he had already formed of the practical physical feasibility of connecting Port Blair with the continent of Asia by wireless telegraphy. That was not a place of which to talk of ways and means, but it was something to know from the head of one of the foremost companies connected with wireless telegraphy that in his opinion the matter was possible. With regard to postal facilities at Port Blair since Sir Henry Norman knew it many years ago, he might say that the Penal Settlement was very much indebted to his individual labours for the success which it had attained. The mail was not once in six weeks or even once a month from the Continent. It was rather peculiar the Government of India allowed them one steamer, which gave them four mails about a week apart, and then it had to lay up for three weeks before they got another mail. The consequence was that they got four mails running and then nothing for about a month, and in the meantime they were without telegraphic communication, which caused both officials and residents a certain amount of inconvenience.

SIXTH ORDINARY MEETING.

Wednesday, December 20, 1899; LEWIS FOREMAN DAY, member of the Council, in the chair.

The following candidate was proposed for election as a member of the Society:—

Bates, Samuel Bakewell, Mingim, Chindwin, Upper Burma.

The following candidates were balloted for and duly elected members of the Society:—

Bevington, Colonel Samuel Bourne, J.P., 42, St. Thomas'-street, S.E.

Burbery, Joseph Stone, Trent-house, Cowes, Isle of Wight.

Gatacre, M. Leicester S., Charlton, Weston-Super Mare.

Harris, C. T., Holly-lodge, Denmark-hill, S.E.

Henry, J. S., 287 to 291, Old-street, E.C.

Standage, Henry Charles, 21, George-road, Witton, Birmingham.

Tebb, Robert Palmer, Enderfield, Chislehurst, Kent.

The paper read was—

BI-MANUAL TRAINING BY BLACK-BOARD DRAWING.

By H. BLOOMFIELD BARE, F.R.I.B.A.

In widening the extent of useful training by the means of drawing, we need the hearty co-operation of teachers interested in the

work, and capable of devising methods based upon actual experience suitably adapted for the curriculum of various classes of schools.

Briefly stated the general endeavour will be directed to training the eye to perception of beauty of form and the hand to skill in delineating what the mind perceives, assisting thereby the development of imaginative and inventive powers more or less latent in every child.

I will here venture to express my opinion, based upon many years' experience, that by the means of blackboard drawing these purposes may be more readily attained than by any other practice with which we are acquainted.

It is too one of the readiest means of ascertaining what there is of latent capacity of hand-skill before the special bent or disposition of each pupil can be recognised or directed towards the various industrial art occupations or handicrafts open to them. In everyone of these occupations or skilled pursuits the same fundamental training of hand and eye is essentially necessary because they consist of one or other form of drawing.

Educational manual training has perhaps a fairer prospect now than ever it has had. More strongly than ever is it urged that manual training through the use of tools and the technical practice of the workshop is too mechanical and narrow in its range to serve for the all-round education which should be the heritage of every boy and girl in our schools.

All have a right to the proper development of physical and mental powers as far as possible, especially of those powers which become less capable of development after the age of fifteen or thereabouts.

There are certain well marked nascent periods which should never be missed, for the opportunity they afford for evoking the full powers of the pupil, for impressing upon him certain facts and forming his disposition. Later the character changes as the child grows, and then perhaps the opportunity has gone for ever.

We should remember that the earliest disposition of the child is towards energetic action, and that the spontaneous activities of the healthy child are in advance of his mental powers. And it would seem, therefore, premature to insist upon abstract tasks and studies until this energy is trained to the working out of thoughts into deeds. We may also take into consideration that there are nervous centres controlling movement, and all efforts of will that produce action aid in developing sensorial areas of the brain, so that the close relation of the powers of the mind with exercise of the muscles acts and reacts favourably in the development of muscle, nerve, and mind.

Again, we should remember that except in connection with his activities and interest the growing youth has slight power of sustained attention, his mental powers are comparatively small.

By the normally healthy child under these conditions, "more is learned by the hand than by the head," and sound mental development proceeds only when it is in harmony with the laws of physical growth. By keeping steadily in view this idea in elementary education we may conserve this natural vitality, while we improve and strengthen the memory, judgment, and imagination.

Every child takes delight in doing something with his hands. In following this natural inclination it can be, I think, judiciously directed through blackboard drawing exercises (properly correlated with other manual occupations) by the training of hand and eye to automatically obey the mind.

By carefully developing the human organism in harmony with physical laws, each individual can make the most of himself or herself, and may become more capable of enjoying one or other of the many occupations of life.

Instead of the artist artisan being so rare, taste may be cultivated with capacity and ability to use it, and this will tend greatly to elevate the handicrafts and to procure a higher quality of product above the mere mechanical processes of to-day, wherein too often now delight is almost entirely lacking.

One essential point is that educational authorities, teachers and parents, should each have an insight into the *modus operandi* of these rational methods, so that each in turn may cordially welcome and uniformly support their general adoption and practice.

In a recently published book, "New Methods of Education," by Mr. J. L. Tadd, of Philadelphia, we have fully laid out an intelligent plan, directing elementary education upon natural and rational lines adapted to all classes and conditions of life, and applicable in each kind of school. It is a method that has long passed the experimental stage; it accomplishes in a most successful manner all that it claims; and it convinces those who have given it practical proof that much precious

ime is wasted in adhering to some of our old nethods.

Mr. Tadd's method follows natural laws in physical and æsthetic development; it helps to acquaint the child with the resources of its own mind, and to realise its individuality; it inspires originality and invention without any overstrain, and gives free play to the creative capacity at every step of the work; whatever the pupil may possess of latent or developed ability, it is calculated to stimulate to increased activity.

The method is carried through courses of drawing on the blackboard, modelling in clay, and carving in wood. These exercises are admirably correlated, and I am able to testify, from personal observation while residing in America, to the excellent results of its working in the various branches of the Industrial Art School of the Public Board of Education in Philadelphia, where Mr. Tadd has been organiser and director during the last twenty years, and where his work is fully appreciated on account of the remarkable manual skill acquired, the artistic development attained, and the originality and energy fostered in the thousands of children who have had the benefits of this culture.

It may be of interest to know that Mr. Tadd, though many years naturalised in the United States, was born in England of English parents, and for generations his progenitors in the west of England have been seafaring captains in British commerce.

Those who have the pleasure of Mr. Tadd's intimate personal friendship find in him a man intensely sympathetic with the young, and enthusiastic in his study of their education upon rational principles; but these traits of character will probably also appear to most of the readers of his book, and all educationalists will feel grateful for the fund of practical suggestion and for the elevating tendency of the work which ultimately must come to be widely recognised in the intellectual progress of this country.

Mr. Tadd enjoins, before seeking to educate the intellect in early childhood, the physical condition and healthy exercise of the body should claim our first attention. In this method of training the attempt is made to co-ordinate physical exercise with development of the will-power, and to expand the mind to the discernment of whatever is beautiful in form and graceful in line.

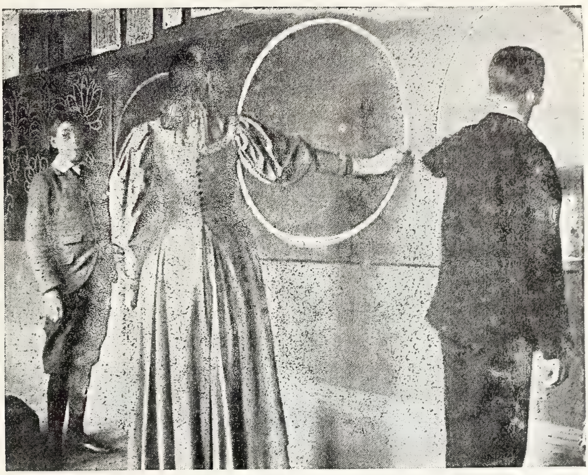


Fig. 1.

Though I strongly advocate the correlation of drawing with modelling in clay and wood-carving, as recommended by Mr. Tadd for purposes of bi-manual training, especially where the course can be followed in its entirety through several years of school life, I can only hope in the brief time at my disposal to explain that portion of the method relating to the blackboard drawing.

Here I wish to say that it appears to be a fact well established by numerous scientific experiments, that the muscles controlling the larger movements acquire ability earlier than those which influence the lesser movements, so that with regard to the arm it is in accord with nature to largely exercise the shoulder

muscles, which have great range of control previous to encouraging smaller work to be done by the elbow, wrist, and hand, which develop their full usefulness later.

In acting upon this principle it is preferred that the first exercise should be with large circles swung with the movement of the whole arm, from the shoulder joint first, with one hand and then with the other, as in Figs. 1 and 2.

It does not matter if these circles are crudely made at first, repetition and practice will correct that. Give all the attention in the beginning to an easy erect position of the body, and the proper distance from the board so as to complete a circle without bending the elbow or twisting the wrist, and without any swaying movement of the body; not too firmly gripping the chalk, but holding it so that the board can be touched lightly and evenly during the whole of the swinging stroke.

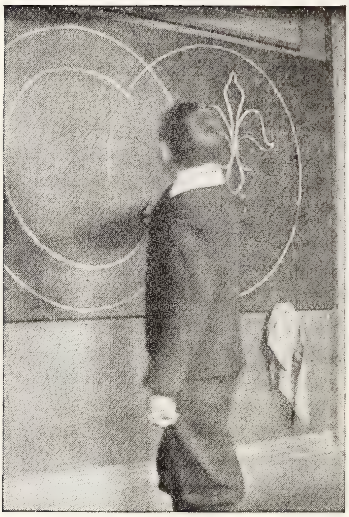


FIG. 2.

Neglect of any one of these minor points displays itself by the inexact form of the attempted circle; the pupil can detect this for himself, and can see where to repair his mistakes; but with a little practice he soon acquires graceful movement and the easy control of the muscles, which in time become automatic, without conscious attention or exercise of the mind, because the motor intuition has been gradually organised in the proper nervous centres, and the will is henceforth equal to the accomplishment of the idea. Just so in writing we unconsciously produce, without waiting to think about the various complex curved forms, the letters which go to make the written word.

The efficiency of these circles and other curved forms (see Figs. 3 and 4) as exercises in giving facility of hand, through free movement of the arm, has been proved by long experience in teaching both children and adults.

A sensitiveness of touch is soon acquired, capable of a light and even pressure of the chalk upon the board, in whatever direction it is employed.

New pupils, who have not had previous instruction in drawing, are often more ready to grasp the forms of the exercises, and to acquire a firm decided line at a single stroke—those who have learned by other systems generally make a series of tentative touches, dotted or lightly sketched lines, with the intention of "lining in" their work more firmly afterwards. It is much better to require firm clear bold lines to be made from the start.

I now come to more special mention of bi-manual training drawing, by which to cultivate and obtain ambidextrous skill.

I prefer, in the first instance, that more attention should be given to the left hand, which needs rather more time allowed to its exercise, to counterbalance its general lack of use, but with the young especially, the left hand soon acquires as much freedom as the right, and there seems to be no strong reason why any distinction should be made, or why preference should be given to the right hand. It would undoubtedly be better that the two cerebral hemispheres, or lobes of the brain, should become equally developed through the equal exercise of the limbs on both sides of the body.

In the ambidextrous practice smaller circles may next be done, using both hands simultaneously. Six or eight changes of movement are practised in this simple drill exercise, which proves to be a very helpful one in synchronising the control over the left hand with that of the right.

Take care that the size of these smaller circles be regulated to come within the focal range for both to be seen at once, and avoid the necessity of moving the eyes or the head, to follow first one hand and then the other; this remark applies to all the double-handed work on the blackboard.

The ability to form these small circles evenly and with ease through the several movements I have indicated is the key to an almost

ndless number of exercises where both sides f the pattern are drawn simultaneously and re practised until the equal performance of

FIG 3.

right and left hands produces well-balanced forms and graceful curves. (Figs. 5, 6, 7.)

While the hands are thus acquiring ambidextrous skill the perception of beautiful line will be impressed with every progressive step.

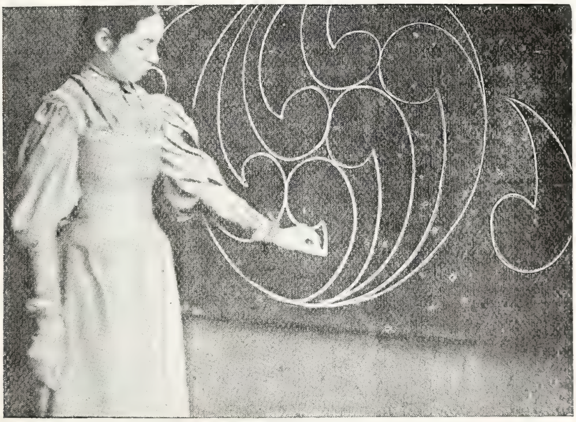


FIG. 4.

The pupil usually finds considerable interest in this part of the training, for the teacher continually diversifies the examples and so avoids too monotonous repetition.

At this stage comes the opportunity of introducing many forms of historical conventional ornament, and others from natural objects and study of plant life, which the pupil will store in his memory and afterwards utilise as motives or units of design for decorative arrangement wherein his inventive faculties may be called into play. I shall refer again to this part of the training presently.

I have a strong preference for continuing elementary practice upon the blackboard mainly with curved forms, such as loops, ellipses, and combinations of circles, &c., before commencing the drawing of straight lines, but these exercises upon straight lines and combinations of rectangular forms come also to be practised until they can be done with steadiness, ease, and freedom in all

directions, vertically, horizontally, and obliquely.

Briefly explained, the exercises upon curved forms more readily serve to bring certain sets of muscles progressively into action and under automatic control, and are mainly useful in developing manual facility and nicety of touch. Drill exercises upon rectangular forms are chosen rather for the purpose of educating the eye to measurement and proportion without the artificial aids of measuring rule or compass.

It is during the period of growth that these powers of the hand and eye should be made fundamental. The use of instruments of precision dull the perception, and make us lean more dependently upon mechanical means instead of cultivating in the mind that power of grasping magnitudes and proportions so essential to the worker in all occupations.

On the principle of "acquiring facility first and accuracy afterwards," experience in the use of this method finds another good reason for reversing the usual order of procedure in drawing. I have noticed generally that children evince considerably more interest at first in the repetition of exercises upon curved forms than in the practice of straight lines and rectangular or geometrical forms: so this natural inclination may wisely be turned to good account. In proportion as we impart interest to the study, so we increase the ability to learn. Certain it is that, after the bold use of the arm from the shoulder-joint—practised in the large swinging circles—the pupil draws a vertical line more upright and a horizontal line more level, and with more decision in each instance, than when these apparently simple problems are forced upon his attention at the beginning.

It will, of course, be distinctly understood by artists and art teachers, fhat these elementary drill exercises are not intended to take the place of art teaching, such as drawing from objects, the study of perspective, light and shade, &c.; but their object is for the definite purpose of giving skill and dexterity to the hand, and thereby supplementing art work in all directions. Art teachers can realise the value of a ready hand, prompt to obey the mind, a hand that by training performs all its movements with facility, as quick as thought. They can also appreciate that time is saved when the eye has been trained early to see the proportion, balance, space-relations, &c., and that this skill is automatic.

Again, teachers will be able to devise drill exercises other than those which have been indicated, such as will arise out of their own experience. Bearing in mind the main principles to be observed, they will modify their instruction in accordance with individual needs

FIG. 5.

nd avoid any rigid adherence to routine, rms, and methods.

At the same time it is regrettable to notice, some few instances where the attempt has een made in public schools to introduce Mr. Tadd's method of blackboard drawing, it has unfortunately been too little understood by those who are striving to overcome the difficulty of adapting existing and insufficient school appliances to a system of teaching untrained in the principles vital to the successful practice of this method; naturally they are unable to infuse the right spirit into it.

Consequently we see in some public schools the ill-advised adoption of an inferior sort of miniature blackboard to be set up in the ordinary kind of school desk at a sloping angle (the surface of the board entirely too small to permit the free use of the whole arm) with about sixty children in one class, ranged before a teacher who is unable to see what they are doing, because only the backs of these boards are visible from the teacher's position.

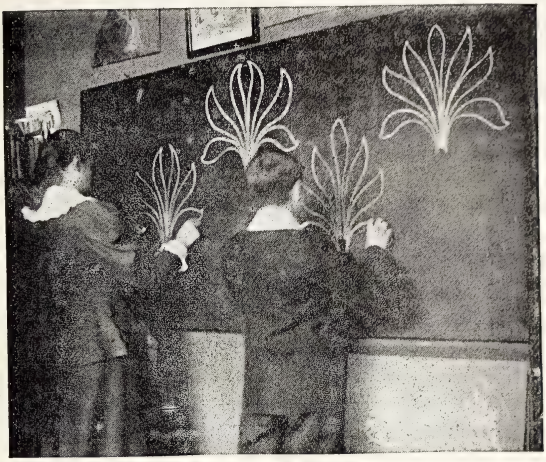


Fig. 6.

Fig. 7.

over-large classes by one person, and, in consequence the attempt is abortive of good result, even if it is not a direct hindrance to educational progress.

Here lies the danger, if the teachers are

With this example of "how not to do it" one cannot help regretting the waste of expenditure of school funds upon inappropriate appliances, together with the consumption of the child's valuable school time, at the most important period—the nascent period of growth.

Hence the necessity for some recognised public authority to organise the adoption of this undoubtedly excellent and practical method by affording opportunities for the training of teachers in preparation for their work in the schools.

It may justly be claimed that with the minimum of special apparatus, this bi-manual training method produces the most skill in the shortest space of time, develops accuracy of perceptive powers, facility of delineation, a strengthening of mental capacity, and a general fitness for the greatest number of the occupations of life. And thus this method is an eminently efficient element for mental and physical discipline through an exercise in which the pupil is always interested.

In no trade or art industry is there an overplus of skilled workers, though there is an undoubted overplus of applicants for clerkships. And for this undesirable condition of things, our present school system is, possibly, mainly responsible.

With the adoption of wiser elementary training, there might be less inclination to look with scorn upon the honest handicrafts, and less aspiration towards the over-crowded ranks of clerkdom.

There is a general recognition now that the backbone of a nation is its class of manual workers, and that a curriculum too exclusively literary, too restricted to book-teaching, tends to give a youth a distaste for the work of his after life. With better training for the increase of hand-skill, we may surely hope to inspire every child with greater liking for manual occupations, other than that of driving a pen upon an office stool; occupations where the dignity of labour may assert itself, the lot of the worker be brightened, and his contentment increased.

Perhaps I may best conclude in Mr. Tadd's words:—"To deprive the child of this training is to rear it in ignorance of its power to use hand and eye, a power that can be mastered at an early age, and a power the proper development of which aids so much towards practical success in the actual work of life, while also aiding the physical, mental, and spiritual welfare of the individual."

[During the reading of the paper, the principl referred to by Mr. Bare were fully demonstrat upon the blackboard by Miss Bare and by the read of the paper.

The illustrations are kindly lent by the Editors the "Studio" and "School World." Figs. 1, and 7 are from the "School World." and Figs. 3, 5, and 6 from the "Studio."

Figure 5 represents practice in Mr. J. L. Tadd class-rooms, the remaining figures are from those Mr. Bare.]

DISCUSSION.

The SECRETARY read the following letter fro Mr. Walter Crane:—

13, Holland-street, Kensingto
Dec. 19, 1899.

MY DEAR MR. BLOOMFIELD BARE,—I very muc regret to have to tell you that I shall have to foreg the pleasure of taking the chair at your lecture at th Society of Arts to-morrow (Wednesday) evening owing to a very sudden attack of influenza. I am under doctor's orders, obliged to keep my bed a present, and must cancel all my engagements thi week. This is a great disappointment to me, as yo know I was looking forward to your lecture and o seeing your daughter demonstrate upon the board Ever since I saw Mr. Tadd's classes at Philadelphia I felt that the method had an important bearing o education, and the remarkable results he reache with quite young children made me feel that ou teachers here would find it of very great service. I was glad, therefore, to learn that you had taken th method up and taught it yourself, and were prepare to teach others, and to call the attention of educational authorities generally to its value. You lectures, given at the Royal College of Art at my suggestion, have, I hope, done something to inform art masters and students of the value in design on a large scale of drawing (and in blackboard demonstration) with a direct free stroke. Our schools o art want more training in direct methods and in facility of hand in line drawing, far too much reliance being placed upon the indiarubber, as a rule, and the tentative pencil line. Apart from this the method has a practical value in giving facility to both hands alike. This is useful enough, but in case of accidents disabling one hand, such as we hear of, an artist could continue his practice with his left.

I hoped to have said at least this much, but I am reduced to write instead, and wishing you all success,

Very truly yours,

WALTER CRANE.

Mr. T. R. Ablett said this paper reminded him of some very old friends. Many things one heard made one think that we were a long way behind America, but what he had now heard made him feel more cheerful. Blackboard drawing was not very novel in England, for at least 75 years ago writing and drawing went together on the blackboard, and he himself in preparing candidates for the South Kensington second grade examination, adopted the line of memory-drawing to produce the details of the acanthus leaf ornament. When he lectured for the London School Board in 1882 he gave a number of blackboard demonstrations, using the free line. This was really old history. In 1882 he went to Paris, and having an introduction to the Minister of Education, he saw the whole of the art teaching there, and found that the French were making immense efforts to improve the drawing in the elementary schools; they had been to America and to England, and had framed a new scheme of work. Before that, in America. Mr. Walter Smith, an energetic man from the North of England, who was sent by the Science and Art Department to introduce their method of teaching drawing, introduced memory-drawing with these sort of forms, and in 1884 he was told by some Americans who were at the International Conference on Education, that Smith's method had already got into disrepute, because, being a practical people, they said they did not want everyone in that great country to design; they wanted to make good citizens, and they thought this ornamental work was much too restricted. In England the same kind of thing was carried through among other stages; one was known as written design, in which the pupils sketched a number of patterns, much in the same way as had been shown. No doubt drawing was a training for the hand, and bi-manual training was useful. But why not train the feet as well? The nervous system was less strained if operations were done with the four limbs, instead of with one, or even two. Drawing with the feet was not a difficult matter, and having mentioned this bi-manual system the other day to a young friend, he produced a drawing, which he now exhibited, as an example of what the foot could do at the first attempt. If bi-manual training was good, it should not be restricted to drawing, but arithmetic and writing should be done with both hands, possibly with both feet. As a fact, drawing was poor manual training—many other forms of work were much better—modelling for instance. He pointed that out to the School Board in 1886, and many modelling classes were started, and at the ensuing Educational Exhibition there would be a good display of models from the London School Board. But there was another method even better—pianoforte-playing, where the left hand had an immense amount of work to do, and in violin-playing the main part of it was done with the left hand. He was rather sorry to see this sort of drawing recommended for children, his view being that a clever child would be ruined by it. The blackboard at the best was but a clumsy makeshift in a class-room; it was far better to draw on brown paper with charcoal, or on a white board, as he had seen in France in 1882, the board being formed of ground glass on which various coloured chalks were used. One objection to the blackboard was that it represented black things as white, and *vice versâ*, it reversed the order of nature, and therefore was puzzling to children. It also gave the maximum amount of friction between the tool and the drawing surface, whereas teachers sought to discover the minimum; that was why they advocated the use of the brush. The large scale of the drawings was also bad for children. It was the experience of artists that it was better to draw on a small scale first and enlarge afterwards. Prof. Charles Verlat, of Antwerp, was very strong on the point that beginners should draw on a small scale; and children in their spontaneous efforts invariably did so. Finally, and this was the greatest objection to blackboard work, it fostered the popular delusion that dexterity of hand was the foundation of drawing. On the contrary it was a mental effort which lay at the foundation, and in dealing with children you might safely leave alone manual work and give your whole attention to improving their powers of observation. As Mr. Briton Rivière pointed out to him once the great advantage little children had was that they went to nature unbiassed and drew what they saw as they saw it. Here, through a long course of training, you put into children's minds a number of conventional forms and sent them to nature to draw, not what they saw, but what they had learned to see. The mental parts of drawing were far more important than manipulation. Many children of six or seven had already conquered its difficulties. Art had suffered immensely by the slackness of the profession in original research. Some artists had a natural gift for art, but no intellectual power; some even attained distinction by confining themselves to one narrow groove. It had been said that, intellectually, drawing was far behind music and literature. This was remarkable, because the high cultivation of the original research in observing led to a sort of natural evolution, by means of which idealism came inevitably from the study of nature. They were endeavouring to have drawing taught as a means of education and at an early age, and he hoped in time they would secure a larger share of the intellect of the country for the artistic profession. At present, if there were a clever boy in a school, the master would take him for mathematics, or classics, or science; it was only the remnant which went in for art. That was partly because the intellectual part of art training had been put on one side from the mistaken view that manual training was the foundation of it.

Mr. J. Pennell said the paper was entitled bi-manual training, and it was all based on the work of Mr. Liberty Tadd; but some years before Mr. Tadd ever

thought anything about this subject he (Mr. Pennell) was working at Philadelphia, and the work of manual training—not bi-manual training—was the invention of Mr. Charles G. Leland, who started a school in Philadelphia, under the auspices of the city authorities, about 1880. Some time later Mr. Tadd appeared; but in the meantime the scheme of modelling in clay and wood-carving (which was the idea of Mr. Leland) was carried out by means of this drawing on the blackboard. It, however, had nothing to do with the very wonderful drawing of which Miss Bare had given them examples. Mr. Leland's idea was to make drawings, and make something practical out of them, not to go on drawing circles until you could do it nearly as well as if you had a pair of compasses. The idea was taken up later by the American Government, who commissioned Mr. Leland to write a book, which was circulated all over Europe and America, and was in great measure the progenitor of that growing institution, Home Arts and Industries. He had not seen Mr. Tadd's book, but it was very unfair if he had not given Mr. Leland full credit for the starting of this work of manual training. He agreed with Mr. Ablett to a great extent. If drawing with both hands was going to lead to this great facility, it was going to be one of the most awful curses that ever befell the world. He did not see what practical use was to be made of it. As to drawing with the full length of arm, everyone knew that some painters used brushes 3 or 4 feet long, and he knew one who used a brush 6 feet long; that was a mere mechanical thing. If Mr. Crane had been present he could have shown them how easy it was to draw with both hands; it could be learned quite readily. A few years ago, one of our most brilliant pen draughtsmen was paralysed on the right side, but in a few months he learned to draw with his left hand, and had done so ever since. As had been said, drawing was really a mental operation, the use of the hands and fingers was a secondary matter.

Rev. J. O. Bevan said he would not enter on the controversy raised by the two previous speakers, but would confine himself to the idea raised by the title —bi-manual training—and would raise what seemed to him a physical reason against it. He thought it must act prejudicially on the eyesight. We had two eyes, but only one focus, and if you accustomed children to disperse their focus, it seemed to him it would lead to all sorts of optical difficulties—squinting, and so on. He might be told that the action was to a great extent mechanical, but it could not be so in its initial stages; the child must watch the operation going on, and that was of a double kind. He had no experience of the subject, because the drawing he taught was mainly mechanical for engineers, to which this mode would not be applicable. The idea of training both hands was no doubt sound, but he thought training them both at the same time was an error. Why should they seek for a perfect balance between the two hands? At an early stage of lif development was to a large extent symmetrical; b there was no need that it should be so in highl developed creatures. Suppose one lobe of the bra was to some extent different from the other, wh did it matter so long as one developed in one directi and the other in another. To a large extent the must be a balance, because many actions we symmetrical—walking, for instance. One would n care to develop one leg at the expense of the othe or we should walk in a circle; but he did not kno why they should differentiate between one hand and th other. It seemed to him that Nature taught thi Most people were right-handed, or, if not, left-handed very few were ambidextrous; but it seemed to hi they were none the worse for it, but rather better. he had to carry a weight he always used his left hand beeause he spent his life mainly in writing, and h right hand had acquired a certain fitness and dexterit which would be injured by carrying a heavy weigh in it.

Mr. H. B. Hagreen said he was much interested as an old teacher, in this matter, and was very glad t find that the good work done by his old friend Walte Smith and others was not forgotten. With regard t blackboard teaching, he felt what had been men tioned as the most serious difficulty—that of gettin sufficient space in a school to teach in that way A certain amount of confidence was soon ac quired; but the thing was done in a ver mechanical way, almost making oneself into a pai of compasses; and it seemed to him it did no bring that refinement which was so necessary. I you began on the old system by teaching a boy t draw a straight line; then made a mark on it an let him find the corresponding position on his owr line, he soon got to know that there was a certair relation between width and height, and it wa that which had to be learned first. They had no heard what was the outcome of all this; had it produced any very competent draughtsmen? He could quite understand that children soon got over the surface, and it might do them some good standing near a large blackboard, but the whole thing might be so excessively large that it must affect the child's vision, so that it would be, to a great degree, an accident what he produced. It was said that it did not matter whether the lines were correct, the great thing was to obtain freedom; but if a child was old enough to draw at all, he should be taught to be accurate in whatever he did. That was his opinion after nearly 40 years' experience as a teacher.

The Chairman said he knew nothing whatever about this system before, but it struck him as being exceedingly interesting and suggestive. He did not mean to say that therein lay the whole secret of drawing, still less of design, but he did think it opened out interesting suggestions, and that the idea

not to be lightly dismissed, even if it might been carried in some respects too far. One g he felt was that there was a distinct ger in too much facility—a danger in a ction from which they were already suffering, of people being too easily satisfied with someg they had done, which came somehow, and ch meant nothing; that kind of swirl which was racteristic of so much modern design, so-called. y had quite enough of it as it was, and if they it twice over—done with both hands—it would eed be terrible. He could not quite agree with . Ablett about the disadvantage of drawing on a ge scale. The reason why the old masters—or any —drew on a small scale, was because it was so ch more convenient; you could get your design ht on a small scale, and then draw it on a scale so that you really could only see part of what you re doing at a time. But where you could manage it, certainly thought it better to make the design the large scale at first. He had had a good deal experience in practical designing, in which he d to begin by making a small sketch for proval and then executing it, and he had also de designs, full size, right off, and he preред the latter mode. With regard to the idea ich had been suggested that children should made to draw from Nature only, and that any ggestion of conventional form was bad, he protested ainst it absolutely. Mr. Ablett complained of ildren drawing only what they had learned to e; it was very necessary they should be taught to e, and what to see. What they were suffering from w was that modern designs were made by ople who had not learned to see, but thought ey knew better than all who had gone before em—that they had only to go to Nature and give nt to their originality—which in most cases was ly original sin. With regard to the board it did ot matter whether it was black, blue, or green. ou could draw equally well with chalk on a black oard or with charcoal on a white one; but there ere great advantages with a blackboard and chalk. n the first place the work was clean, and next, you ere rather encouraged to rub it out and begin again it was not quite right, instead of fumbling for the ght line. You generally had it wrong to begin with, nd if it was on paper you did not like the trouble f rubbing it all out. The blackboard encouraged you o do so. He would conclude by moving a vote of hanks to Mr. Bare for his very admirable paper, nd to Miss Bare for her demonstrations.

The vote of thanks having been passed unanimously,

Mr. Bare, in reply, said he thought sufficient heed ad not been taken of the fact that this was not put orward as a method of teaching drawing, but of iving facility of hand and accuracy of eye, which vas of great advantage in numberless occupations and handicrafts. He was something of a practical woodcarver, and he knew that if he could take a tool in his left hand, and work equally well with it, it saved him a great deal of time in shifting his work about until he could get at it with the right hand. Most wood-carvers acquired that after years of experience; but the fundamental facility ought to be given in the training of young children. It was not to make artists of them, and it was not necessary that an artist should use his left hand equally well with his right; but it was the facility desirable in so many occupations that they endeavoured to get by this work on the blackboard. One gentleman referred to the amount of friction in drawing with chalk, but that was one of the very points he tried to make—that in overcoming that friction the hand was trained to the delicacy of touch which was required, just as much as in playing the piano or violin. In Mr. Tadd's book, Mr. Leland's claims as the originator of the great scheme of manual training was very fully acknowledged. On Mr. Leland's departure for England Mr. Tadd continued the work in Philadelphia, and became the organiser of it on a larger scale. The whole point was this. There were many systems of teaching drawing, but this was not brought forward in that way at all. At the time Mr. Leland and Mr. Tadd were working together, the idea of manual training was that it was to be attained entirely through the use of mechanical tools. Educationalists now went beyond that, and said that was not general or wide enough in its scope; but that drawing, modelling, and woodcarving seemed to cover the ground to a much larger extent than the mere use of carpenter's tools. It was not sought to make every one a designer or an artist; but this facility of hand gave a certain amount of play to the imagination in a way very few other systems of manual training would do. With regard to one objection raised—that this was introducing conventional forms rather than natural ones—he might repeat what he had already pointed out, that the skill which came in this way was of great use in the delineation of natural forms.

Miscellaneous.

COAL IN CANADA.

Mr. George Johnson, the Government of Canada's statistician, has prepared some useful information with regard to the coalfields of the Dominion, which is quoted in *Industries and Iron*. From this we learn that the coal areas of Nova Scotia cover about 635 square miles, and are divided into the Cape Breton, the Picton, and the Cumberland basins. The workable thickness of the coal is very great; in Cape Breton it ranges from 25 ft. to 60 ft., in Picton to at least 70 ft., and in Cumberland at least 30 ft.

If the workable area is reduced one-quarter, say from 407,400 acres to 300,000 acres, and the average thickness of the workable area put at 25 ft., on the basis of 1,000 tons of coal an acre for every foot of coal, the amount of the coal in the measures of Nova Scotia is 7,000,000,000 tons." So far as the quality of this coal is concerned the following are analyses of samples from each of the three basins:—

Coal From	Water.	Vol. com.	Fixed carbon.	Ash.
	per cent	per cent	per cent	per cent
Cape Breton	0·75	37·26	58·74	3·25
Picton	1·19	29·10	60·63	9·34
Cumberland...	1·46	33·69	59·35	5·50

In 1898 2,563,180 tons (2,000 lbs.) were produced, as against 1,918,827 tons in 1889, ten years previously. The erection of large iron and steel works at Cape Breton this year, and the enormous manufacturing activity which is being shown in the province, cannot fail to maintain and increase the extension of coal mining which 1899 has shown.

The coalfields of Manitoba and North-west Territories are the only coal measures in Eastern Canada. The coal areas of the Prairie Province are roughly estimated at 15,000 square miles. They yield lignites only, and of a very good quality. In the North-west Territories there is a coal area of about 50,000 square miles which extends along the base of the Rocky Mountains from the International Boundary to the vicinity of the Peace River—a distance of some 500 miles. The analyses of the coals of Manitoba and the North-west Territories are as follows:—

Coal From	Water.	Vol. com.	Fixed carbon.	Ash.
	per cent	per cent	per cent	per cent
Manitoba	15·40	37·97	41·21	5·36
Belly River...	6·52	31·03	56·54	5·91
Bow River	12·37	32·33	46·39	8·91
Peace River	2·10	21·54	71·63	4·73

Practically the whole of the development of these areas has been in the past decade. In 1889, only 97,364 tons (2,000 lbs.) were produced in Manitoba and the North-west Territories; but in 1898 the production had increased to 340,088 tons. The quality of these coals is shown by the two following analyses:—

Coal From	Water.	Vol. com.	Fixed carbon.	Ash.	Sulphur
Queen Charlotte's Island...	per cent 1·60	per cent 5·02	per cent 83·09	per cent 8·76	per cent 1·53
Vancouver Island					
Slow Coking	1·47	28·19	64·05	6·29	—
Fast Coking	1·47	32·69	59·55	6·29	—

General Notes.

TRAMWAY EXHIBITION, 1900.—An Exhibition, devoted to tramways and light railways, will be held at the Agricultural Hall, Islington, from June 30 to July 11.

ELECTRIC LOCOMOTIVE FOR THE JUNGFRAU.—The electric locomotive constructed by Brown, Boveri Co., destined for the Jungfrau Mountain Railway, is said to be the most powerful rack-wheel machine hitherto constructed, and is designed to haul trains over the steepest portion of the road. The motors are placed under the passenger cars, whereby greater adhesion between the driving wheels and rails is obtained. The car truck is provided with two bearing axles and two driving axles, the latter being situated between the former. Two motors, each of 125 h.-p. at 800 revolutions per minute, actuate the toothed wheels through the medium of duplicate gearing. If required, these motors are capable of working up to 300 h.-p. The driving current is conveyed overhead at a tension of 500 volts. The pivots of the toothed wheels are of aluminium-bronze, the teeth being of cast steel.—*Feilden's Magazine.*

BELGIAN ARTIFICIAL STONE.—An artificial stone from Belgium has recently been introduced into the French market, which is said to have four times the force of resistance of French freestone, and which has nearly all the properties of Cobestang granite. Consul Atwell, of Roubaix, states that it has been tried in the Malines Arsenal, and is found to be insensible to the action of cold, absorbs only 6 to 7 per cent. of water, even after a long dry spell, and cannot be crushed under a pressure of 40 kilogrammes (88 lbs.) to the square centimetre (square centimetre = ·155 square inch). This artificial stone is manufactured at Uccles, near Brussels, in the following manner:—Eighty parts of extremely clean and dry coarse sand are mixed with 50 parts of hydraulic lime reduced to a fine dry dust; this mixture is put into an iron box, which is plunged into a boiler of water, and this is hermetically closed. During 72 hours the cooking goes on under a pressure of six atmospheres, the temperature being maintained at 165°. At the end of this time, the iron box contains a perfect homogeneous mass of stone which rapidly hardens upon exposure to the air. The most varied colours are given to this stone, and its manufacture costs only one penny per cubic foot.

JUVENILE LECTURES.—A course of Juvenile Lectures will be given at the Royal Institution, by Prof. C. Vernon Boys, on "Fluids in Motion and at Rest." The first lecture will be given on Thursday afternoon, the 28th December, at 3 o'clock, and the second on Saturday, the 30th, at the same hour. The Juvenile Lectures at the London Institution will be by Mr. A. H. Fison on "Light and Colour." The first lecture will be on Friday, December 29th, at 4 o'clock.

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[Al]l communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

The usual short course of lectures adapted [fo]r a juvenile audience will be given on [W]ednesday evenings, January 3 and 10, 1900, [a]t 7 o'clock, by Herbert Jackson, on "The [P]henomena of Phosphorescence."

The lectures will commence at 7 o'clock. [S]pecial tickets are required for these lectures, [w]hich can be obtained on application to the [S]ecretary. A sufficient number of tickets to [fi]ll the room will be issued to members in the [o]rder in which applications are received, and [th]e issue will then be discontinued. Subject [t]o these conditions each member is entitled to [a] ticket admitting two children and an adult. [A] few tickets still remain, and members requir[in]g these should apply at once.

LIST OF MEMBERS.

The new edition of the List of Members of [th]e Society is now ready, and can be obtained [b]y Members on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

ART ENAMELLING UPON METALS.

By Henry Harding Cunynghame.

[L]ecture I.—Delivered November 20, 1899.

The word enamel seems to be derived from [t]he German, smeltzen — to smelt. It was [o]riginally spelt esmail, whence it became [é]mail in French, and enamel in English.

The art consists in melting glass on to [t]he surface of any body that will bear the [n]ecessary heat. Thus we have enamelled [m]etals and enamelled pottery. Clay as you [k]now consists of silicate of alumina and other earths, and shades away from refractory fine clay to porcelain, which melts at no very great heat; that the glaze on all these materials consists of glass.

Glass is a silicate or borate of some of the alkaline earths, or else a silicate of an oxide of some metal. In its simplest form, glass consists of silicate of soda or potash. When the amount of the alkali is only about one-sixth or one-fourth the weight of the silica, the glass is practically insoluble, but the more silica is added the more soluble the glass becomes until when the alkali amounts to four or five times the quantity of the silica the glass becomes soluble, and is known as "water-glass."

A mere uniform glaze of glass, such as is used to cover pottery and porcelain, is sometimes termed enamel, but more strictly the word is only used when the glaze is laid on so as to form a design. The use of the word should also in strictness be confined to cases in which coloured glass is employed, laid on in masses like washes of colour, and not to work painted with a brush.

Thus when china or metal is covered with solid coats of glaze it is said to be enamelled, but stippled ornaments or landscapes upon Dresden china, or Battersea ware, are not enamels properly so called.

In practice the word is loosely employed, and it is usual to call all applications of melted glass upon metal by the name enamel, so that the term is employed for saucepans and other kinds of household ware made by coating iron with vitreous material. The so-called enamels used on bicycles are not true enamels, but only preparations of pitch or other resinous substances, which are hardened by baking them for two or three hours in ovens at a temperature rather higher than that of boiling water. Used in this way, common Japan black produces a hard and beautiful surface; but it is not a true enamel. Enterprising tradesmen sometimes mix two or three pennyworth of paint with a hard varnish, strain it, and sell it in tins as "enamel." Ladies' faces are also "enamelled" by the application of certain cosmetics. But these are all improper uses of the word.

It has been found that several metals, among which are gold, silver, iron, copper, and fine bronze, that is to say, copper with a small admixture of tin, are capable of being covered with glass, fused on to them by means of heat. But to other metals, such as nickel, or zinc, or brass—which is a mixture of copper

and zinc—the glass will not adhere. The usual method of applying the glass is to reduce it to fine powder, to spread it over the metal in a thin layer, and then to put the metal into a furnace raised to a red heat, until the glass melts.

Glass is coloured by melting it with the oxides of various metals. Oxide of tin makes it opaque white, iron gives a sea green and a yellow, cobalt a royal blue, copper a turquoise blue. Manganese colours glass violet, silver and antimony yellow, and gold crimson. These were the metals used by the old enamellers. In addition we now have chromium, giving another shade of green; uranium, a fine yellow; and iridium, giving steel grey and black. The nature of the glass used in enamelling, and the mode of making it, colouring it, and applying it to metal will be fully explained and treated practically in the subsequent lectures.

The use of coloured glass as a decoration is very old. Its first application was upon clay. Some of the oldest examples of early enamelling are to be found in the greenish blue figures which the Egyptians put into tombs in order that they might serve as servants to the dead in the next world. Its use upon metal is, however, more doubtful; many pieces of Egyptian metal work that appear to have been regularly enamelled only consist of pieces of glass, marble, or precious stones cut out and cemented into cavities in metal.

The Celts and the Goths appear to have been acquainted with the art of enamelling, which they probably learned from the Byzantines. A very few pieces of Greek work have come down to us which are undoubtedly enamelled, but it does not seem probable that in the best period of Greek art enamelling was much practised.

The first extensive use of it as a decoration was by the later Greeks, who lived in the vicinity of Constantinople when that town, under the name of Byzantium, became the metropolis of the Western Roman Empire. But the remains of Byzantine art present such curious features, and when considered without reference to their historical origin appear to modern eyes so grotesque, that it is necessary to enter into some further explanations regarding them.

If we examine the remains of past Roman art in the catacombs, we find the most unmistakable indications that they were derived from classical models. The vestments though badly drawn are obviously togas arranged with the folds that we know so well in Roman statues.

But a change has come over the spirit of the art. The old joyous human life has been eliminated, and at first sight we are inclined to think that the art is wholly dead.

Thus, for example, the frescoes at Pompeii reflect a good deal of the voluptuous life enjoying spirit of classical art. They are mere shadows of pictures that have ceased to exist, executed by hack artists in coloured whitewash, who did the work that is done by paper-hangers in our own day. But there is in them a distinct trace of their origin. When, however, we turn to early Christian frescoes as that before you, we see that all joy has faded out of it, and almost all feeling for human form; the eyes are staring, the posture constrained. In truth, however, a new spirit has entered into art, and this is its first development.

The early Christian Church had before her eyes the spectacle of a world which had perished through the immoderate use of art. Weary of the babbling of the schools of rhetoric, men turned to the silence of the cloister. The desert was a necessary protest against the gormandism of later Roman times; celibacy was a reaction against universal sexual profligacy.

And the Church, therefore, seems to have resolved to curb the arts, and for the future to retain them in the strictest leading strings.

The languishing embraces of graceful Greek gods were exchanged for the severe and even repellent types of Byzantine mosaics. But this very restraint, salutary as it was while the morals of Europe were being reformed, was not without disadvantages; for where literature or art is in complete subjection to a system of morals, religion, or politics, it is certain to be cramped, down and kept in bondage by artificial rules, which destroy its vitality. Therefore, though the fire of Christianity purged classical art of most of its dross, it destroyed a good deal that was valuable in the process.

Thus the extraordinary capacity which the Egyptians displayed for sculpture and painting was diverted by the influence of the priests into a monotonous circle of endless repetition; and Christian art in the East was subjected to a written code by which the exact position and dress of each figure, the colour, and attitudes were minutely prescribed, and no departure permitted from rigid rules.

It is no reproach to religion that it should

ve restricted art. A man whose thoughts : wholly occupied with spiritual things turally values pictures or images purely for : spiritual ideas presented by them, and may en be disturbed and repelled by the intro- ction of mundane beauty. The rejection of nate ritual and church decoration is partly ie to this feeling. But it is also true that ı art which is intended to appeal not to nchorites or Puritans, but to ordinary men, ust satisfy not only the moral, but also the sthetic sentiments. Therefore the perfection national sacred art is seen when the highest auty has been reached without the sacrifice pure and noble religious feeling. The work art must, so to speak, have a noble soul ıshrined in a beautiful body.

Byzantine enamel was always of the kind ıown as cloisonné or "partitioned." It was ade by marking the outlines of a drawing pon a plate of gold, and then soldering on the old plate, over those outlines, small strips of ɔld, about $\frac{1}{100}$th inch thick and $\frac{1}{50}$th inch igh. These, like small hedges, mapped out ie surface into areas, which were then filled ith powdered glass, melted in by means of eat. The designs were very rigid and conven- onal, and at first sight, to our eyes, appear ven ridiculous; but this is because Byzantine rt has always for centuries been subject to a ritten code of rules, specifically directing how arious religious subjects should be treated. Io scope was therefore afforded for originality, ut he who will examine Byzantine enamels, rom the point of view of those who ordered nd executed them, will find much to admire. The gestures of the figures are symbolic, and ven in a sense mystic. They are religious iieroglyphics rather than pictures, but as an ıssistance to devotion to those who were work- ng out the conceptions which the Eastern Church brought as her contribution to Christian heology, they were probably more effectual han creations of later date.

Towards the end of the 6th century the Greek or Byzantine Church seems to have ıccomplished its mission. It had com- nenced and set on foot a new style of art— he Byzantine. It had contributed largely owards the formation of early Christian heology, it had originated and developed he monastic system; then, as if stricken with palsy, its work ended. Painting has gone on from that day to this; many churches in Greece, and most homes in Russia ıre still ornamented with icons. But the spirit of them is the same as the spirit of Byzantine work. The example here produced of Russian work of this century is exactly the same in feeling and artistic knowledge as a piece of Byzantine work of the 4th or 5th century.

But shortly after the thousandth century the human spirit awoke. In that year it was be- lieved the world was coming to an end, and this feeling paralysed the arts and even in- dustry. When it was found that the end was not yet, life began to be considered worth living.

In Italy a school of architects, known as the Comacine School, had handed on the traditions of classical architecture, but with such modifications as Gothic spirit suggested. But the awakening came in the 13th century.

In France and Germany Gothic architecture awoke to life with the invention of the pointed arch, and the satellite arts of painting and sculpture followed the lead, so that the 12th, 13th, 14th, and 15th centuries present a regular and continuous progress. This age witnessed the building of the great cathedrals; but in spite of the apparent increase of episcopal power a revolt had commenced against ex- cessive clericalism, and architecture and the subordinate arts experienced the effects of it.

Human emotions and sentiments and passions began to be introduced in connec- tion with sacred subjects, and formal tradi- tions were abandoned in favour of a study of nature. The way was being prepared for the Renaissance and Reformation. Under this influence the arts bloomed into the fairest forms. The capitals of pillars were festooned with field flowers; lizards and animals nestled in the foliage; kings, hunters, and handicrafts- men were represented in stone.

Painting, in the hands of the early Italian masters, cast off old rigid Byzantine traditions, and the faces of Madonnas and of the infant Jesus began to beam with human sympathy, while at the same time the limbs approached more nearly antique models, and the drapery became more flowing and natural. At this period art was imbued with the feeling for humanity, without having lost the inspiration of the divine. This union of the sublime and beautiful was the secret of its success.

The characteristic of Gothic times was carving. Almost all ornamental things were produced with the knife and chisel. Wood and ivory have never been so splendidly treated. Accordingly the mode of making enamels underwent a corresponding change. Instead of being fused into cloisons, the glass

was melted into cavities cut out of solid metal. This is called champlevé. It is not clear from whence this art originated, but it is certain that Limoges speedily became its head-quarters. There is reason to think that it was imported from Venice, from which place also came the lead-glass necessary to make it. The Venetians had in their turn probably learned the art of making the glass from Constantinople.

The metal employed as a foundation was bronze, that is to say, copper mixed with about 10 per cent. of tin, or else brass (copper and zinc). The hollows were cut out to the depth of about one-twentieth of an inch and left rough at the bottom, so as to give a better hold to the enamel, which was opaque, and made by staining opaque-white enamel with the oxides of various metals, so as to produce two or three shades of blue and green, yellow and black.

Opaque-white was made by melting glass with "putty powder," or *poudre d'étain*. This is obtained by skimming off the oxide that forms upon melted pewter (a mixture of tin and lead). Putty powder is also used for polishing glass. The colours used for staining the opaque-white glass were "saffre," an ore containing cobalt and sulphur, which gave blue. Turquoise was obtained from the black scales that form upon copper when it is raised to a red heat, green from the scales that form on red-hot iron. Yellow was got from antimony, and red from iron, and also by a special treatment from copper.

The faces in Limoges champlevé were generally left unenamelled, but chased up and filled in with black, like church brasses. Sometimes the heads were modelled in relief, and fastened on with rivets. Each colour was usually put in a separate compartment, but sometimes two colours will be found in juxtaposition in one compartment. The face of the enamel was ground and polished, and the metal work was frequently gilded by the mercury process, which only requires a low heat. The mercurial process of gilding is one of great antiquity, being mentioned by the monk Theophilus, who wrote in the 11th century. It was employed till it was replaced in the present century by electro-gilding. It is more durable and beautiful than gilding by electricity, but is tedious and dangerous to the health of the workman.

Gold was also used for champlevé work, but usually (except for jewellery) with transparent enamels. Unfortunately these works have been mostly melted up, but what remai of them must make us bitterly regret what h been lost. The later style of this is calle "basse-taille," and consists in carving o a subject in a thick plate of gold in low relie The mode of execution is like that used by th Egyptian sculptors. A firm, sharp outline cut, and the figure is moulded within it. Th object of the Egyptians in this sort of sculp ture was that the sunlight, by casting shadow, might produce a firm black outlin round the figure, making it look as thoug outlined in black paint. This plan, whe skilfully used, has a most striking effect. similar result is attained in basse-taille by th greater depth of the enamel round the edge The colours were melted all over the work, n partitions of gold being left visible. Th whole was then ground and polished. Th effect is exquisite. The colours employed wer a beautiful transparent red made from coppe or perhaps from gold, yellow from antimony o silver, violet from manganese, steel-gre (manganese mixed with cobalt), and blues an greens of cobalt, copper or iron.

The characteristic of 13th century a was its practical and didactic character. was still in the service of the church, an was distinctly used as all true art must b —as a means to an end—namely to play upo and educate and influence the sentiments an emotions of man.

The didactic character of mediæval sacre art is very clearly seen at Amiens, where th cathedral is covered with a systematic serie of representations of Biblical history. Th painted glass in most French cathedrals wa also upon a similar plan. The painted glas in the church at Fairford, Oxfordshire, i arranged so as to tell the story of Christ fron His birth to His final coming again in glory t judge the world. Until the Renaissance ecclesiastical art was generally very highl symbolic. The twelve prophets were con sidered as types of the apostles, and ever legend was invested with a mystical meaning Those who desire to see how far the use o parables can go, may with advantage consul that curious storehouse of old tales known a the *Gesta Romanorum*. The Roman ritual i entirely symbolic from beginning to end.

In their desire to offer what was precious t the service of God, mediæval Christians de lighted to fix jewels in gold mountings upo the picture, either studded upon the robe o the Virgin or on the breasts of the saints. I early enamels these jewels were represente

dots of gold and coloured glass. The stom of dedicating gold and jewels to church e is now obsolete; indeed, we now use little our churches but distemper in stencilled tterns and cast brass ornaments, the whole rk being done by contract by some trades-n. Sometimes, to keep up the illusion, we ve to the figures the staring eyes and rigid apery of Byzantine times. These miserable itation fossils of bygone ages are the as-nishment of the poorer classes, who wonder y the artists who decorate churches draw so uch worse than the pictures in the penny ustrated papers. But to appreciate Byzan-e and Gothic work it is necessary to enter to the spirit of those who valued relics, and bscribed great sums of money to make rines for them, and even fought battles for eir possession.

But towards the end of the 15th century, e public, though still under the domination of othic traditions, had imbibed a considerable nount of Renaissance taste and feeling, which anifested itself in a desire for a more free and tural style of drawing. There therefore ose a demand for fresh work in enamel, more accordance with the new style of art that as gradually gaining ground. In response to is demand, a totally new mode of enamelling as invented, derived partly from the jewellers' ork of the day, partly from the art of glass indow painting. It is not clear where this vention was made, but it seems to have been troduced simultaneously in Italy, Germany, nd France.

The new method consisted in covering thin lates of metal with layers of coloured enamel, o longer melted into the recesses of cloisonné r champlevé, but made to flow over the whole late or parts of it, and in gradations of thick-ess, whereby gradation of tint was obtained. he town of Limoges again took the lead in is manufacture, and retained its supremacy o effectually, that this sort of work is known s "Limoges enamel." It seems certain that he members of the Penicaud family who prac-ised the art of glass painting were the first to xecute this new work in Limoges. They took s their models the coloured pictures which dorned the breviaries of the day, and which ere in the Flemish style, with French in-uence.

"Nardon" (that is to say "Leonard") enicaud was apparently the eldest of the amily. His method was—having covered a hin plate of copper, or bronze, with a layer of paque-white enamel—to paint, with a brush or pen in dense black upon the surface so obtained, a picture in strong outline, so as to resemble one of the coarse, strongly cut wood-cuts of the period. This was fired to melt the surface of the enamel, and fix the black out-lines much in the same way as a black print upon a piece of china. To do this the charcoal furnaces then in use by glass painters were no doubt employed.

The next step was to cover the drawing with layers of transparent enamel, much as one would colour a wood-cut with paint. Nardon used five transparent colours, namely, two shades of saffre (cobalt), turquoise made from æs ustum (oxide of copper), grass-green from crocus martis (iron), and violet from "peridot" or that form of manganese ore which is found near the town of Perigueux in the vicinity of Limoges.

There appears to have been no transparent red among the colours used by Nardon, except small buttons of ruby placed upon little spots of gold leaf to represent jewels, which were freely sprinkled over the picture.

For flesh, a reddish tinge of violet was used. This was done by painting the faces with a strong tint of violet, made from manganese and iron, and then, after this was fired, work-ing over it with opaque white in gradations, so as to let the violet ground show through in the thinner parts. This work was called "grisaille," being the name then employed for white shaded work in painted windows. A thin glaze of violet was sometimes then put over the grisaille.

Metallic gold was lavishly used by Nardon Penicaud, though, owing to the imperfect way in which it was fired, a great deal of it has been rubbed off in the specimens of his work which we now possess; probably he used borax with it, a fatal practice. Not only was this gold painted in on the high lights of the drapery, but it was dotted in stars over the sky, or in curling ornaments or tongues of fire over the backgrounds.

He used red oxide of iron, that is to say, ordinary rouge (crocus martis), to represent blood, and sometimes upon the lips, but he did not employ this rouge otherwise. The principal tone of the colouring is cobalt and turquoise. The effect is most rich and har-monious, though the peculiar purple tone given to the flesh by the violet underground somewhat mars it.

There is an indescribable charm about Nar-don's best work, due to the fresh and ingenuous expression of the faces, and the skill with which

his simple colours are contrasted and united. The gold also gives delicacy and richness, and as the designs are usually taken from the best work of the great Flemish masters, the composition is generally excellent. His most famous successor was "Jean."

It is not known what relation Jean Penicaud was to Nardon, probably a brother. He is sometimes called Penicaud II. in the catalogues, sometimes Jean Penicaud III. His style resembled that of Nardon, and he used the same colours. The general tone of his work is no longer blue, as in the case of Nardon, but a more natural combination of various colours tending to a rather excessive use of a brownish yellow, a fault that is sill more exaggerated in his successors. In his work transparent grounds for the first time appear, the copper being sometimes covered over with a layer of transparent glass, on which the design is drawn in black, and fired, and then covered in parts with grisaille, then with coats of colour, and finally again with grisaille. Jean Penicaud II. used paillons largely, that is to say, he placed gold leaf about the thickness of tissue paper on the enamel, fired it until it adhered, and then placed other coats of transparent coloured enamel over all. This mode of ornamentation had been known for centuries to the makers of glass goblets. Sometimes he shaded the grisaille, not by gradations of thickness, but by line-shading, made with a steel point in the layer of grisaille before firing, which caused the dark ground on which the grisaille had been laid to appear, and gave an effect as of etching.

He occasionally covered the whole plate over with gold leaf, so as to gild it completely. Upon this the design was painted in black, then tints of colour, and finally grisaille over all. There is a fine work of his in this style in the Cluny Museum at Paris. His skies are usually deep blue in the upper part, shading down into turquoise at the horizon, with small clouds or gold stars flecked over them. The same violet tones are used for flesh as in the work of Nardon. Sometimes, but rarely, there has been a little stippled shading to help the effect. The immoderate use of paillon grounds by J. Penicaud II. has often greatly injured the stability of his work. Fortunately, the gold was beaten badly, so as to be in holes in some parts, and thus cause stronger adhesion.

The work of this artist is not well represented in the Louvre Museum, but the Museum at Cluny possessess some excellent specimens. At South Kensington there is a splendi series of enamels, representing scenes from th life of Christ.

This beautiful work I have the pleasur of being able to show you to-day. Taken a a whole, I should pronounce it the fines enamel in the world. The whole art o enamelling may be learned from it. Ther is not an artifice which the artist did no know, and the modern revival of the ar has only added a few more colours.

I have placed beside this work a little piec executed in the same manner. Of course yo see the artistic inferiority, but I want you t observe that the modern colours are in ever way comparable with, and even brighter than the old ones.

Whence let us take courage. If we do no rival and excel the ancients the fault is in us not in the materials.

During this period, that is to say, the end o the 15th century, there seems also to hav been executed some of the work known a plique-à-jour. This is done by forming a number of cloisons without any foundation, s as to resemble a sort of grating, into the interstices of which enamel was melted. The effec is that of filagree work, filled up with variousl coloured transparent glass. Very few pieces have survived. In the life of Benvenuto Cellini he relates that Francis I. showed him a specimen, and that he imitated it. There is n difficulty in this work, the method of which wil be described hereafter. It is done to a limite extent at present in Russia. But genuine ol specimens are exceedingly rare. Work in thi style is executed in Geneva and in Sweden.

The progress of enamelling which has bee above described, carries us well into th 16th century. But a great change was a hand. Under the influence of the revival o classicalism, and in the hands of Carpaccio the Bellinis, Botticelli, and Leonardo da Vinci painting assumed the most exquisite forms The Florentine architects infused the spirit o classical ornament into Lombard and Gothi architecture, so as to produce a new style, o which the scuola of St. John the Baptist a Venice or the tombs of the Scaligers at Veron are examples. In the hands of Ghiberti, Donatello, and Luca della Robbia, sculpture an modelling rose to new forms of beauty, whil the genius of Michael Angelo crowned the worl by his majestic creations.

If the influence of the classical movement ha stopped here, it would have been productive o unmixed good, and might have resulted in a

· and beautiful style, which would have e on developing for centuries. Unfortuely, however, the taste for classical learning sed due bounds, and took such a hold upon as to destroy its vital energies. Classical ory or fable almost monopolised the subs of pictures; classical costume became versal. Madonnas were made to represent ldesses. The dignified angels with pristic wings of the 15th century gave place nfant cupids. If the nude was to be repreted, artists could think of nothing better n the Judgment of Paris, or Perseus and dromeda, or the chaste Lucretia, who was quently represented as having prepared for ath by divesting herself of all her clothing.

In desperate endeavour to give some modern erest to this hack-work, it became usual to t the heads of the patrons of arts on the dies of Æneas, Julius Cæsar, or Alexander; d where modern battles were painted, the nbatants were represented either naked, or the dress of Roman soldiers.

Thus began the reign of pedantry, in which was admired, not because it gave pleasure profit to the spectator, but because it orded an opportunity for the display of ssical learning. For what interest could ordinary mind take in such scenes? Who res about the birth of Venus, or the rape of ropa, except as a means of displaying autiful nude figures? How wearisome, even en done by the greatest artists, appears e well-worn "Fame" upon a tomb, with trumpet and a wreath of laurels, or Patience" upon one side of a monument iling at "Grief" upon the other. Such art this was deficient in soul. It had ceased to aw its inspiration from the social or religious e and feelings of the people. It appealed longer to the masses, but only to a group *illuminati*. Its roots were severed from dinary human pleasures and aspirations, and death became only a question of time. It ed hard, poisoning by its corruption the art all Europe, and ending with death's-heads d skeletons on tombs, grinning satyrs, stone ouds, empty niches, pot-bellied Pompadour rniture, and scrolls of fame, with nothing scribed upon them.

Unfortunately for France, the Renaissance, stead of being allowed to exercise a gradual fluence, was introduced suddenly and in its orst form by Francis I. If he had only atronised Leonardo da Vinci and Benvenuto ellini, nothing but good would have resulted. s it was, architecture in his time kept clear of the Renaissance influence; but, unfortunately for painting, on his release from captivity, he persuaded Rosso and Primaticcio, two pupils of the school of Giulio Romano, to superintend the decoration of Fontainebleau. Both, especially Rosso, were men of more than mere talent; but they brought with them the whole paraphernalia of faded classical allegory. In consequence, Dido and Æneas, Diana and Actæon, Venus, Hebe, and the kindred tribe of hackneyed goddesses, sprawled upon clouds, over wall and ceiling, in France for three hundred years.

Rosso and Primaticcio were surrounded by a number of engravers, among whom Etienne de Laune, who engraved patterns for jewellers was especially followed by enamellers. The engravings of Marc Antonio, who made bad copper-plates from Raphael's designs, were also much used.

The most remarkable of the enamellers who adopted the new style was Leonard Limousin, that is to say, "Leonard the Limousin," possibly so called to distinguish him from Leonard Penicaud, or from Leonard Tirney, a distinguished engraver of that epoch. Leonard possessed real talent, and in order to retain his services Francis I. gave him the post of one of his valets, and assigned him a small salary. He worked in every conceivable way. Sometimes he put transparent ground on the copper, sometimes opaque. He rarely used a black ground, except for portraits, and the black outlines in his enamels are usually painted with a brush. Like his predecessors, he had a limited number of colours. In the high lights, instead of putting white grisaille work under the colour, he put it upon the top, which gives a chalky appearance. One is bound to admire many points in his drawing, and, considered simply as an artist, he was the greatest enameller of his day. But his work is often very bad in colour, and frequently exhibits the absurdities and trivialities of the Italian school without its merits. Perhaps one of the reasons why his enamels appear tedious is the constant recurrence of muscular Roman centurions in yellow and blue, with helmets, cuirasses, tunics, bare legs, and sandals. He also caught some of the worst tricks of posing and posturing, and impossible undulations of the body, which distinguish the Italian decline.

There is, however, one department in which he easily occupies by far the highest position, namely, portraiture. His portraits were painted from drawings or pictures of excellent character. These he sometimes copied on a background

of black enamel. The face is put in with thick white grisaille, over a coat of black, and painted up with fine stippled opaque-red colour, made from rouge. The clothes are generally shining black, touched with gold, or else with unglazed black. The background is almost invariably of cobalt-blue, laid over a coat of white. The white enamel used to represent the skin is of the colour and appearance of egg-shell, with a low polish. The general tone is whiter than is natural. The eyes are usually scratched out of a dark background' but the mouth and other lines and wrinkles are painted upon the white. The clothes are often shaded in lines scratched through to a dark under-ground. The delicate white appearance of the skin gives an air of great distinction to the portraits, and harmonizes with the black and blue of the dress and background, which fuller colouring would have failed to do. Sometimes a high colour is given to the cheeks with oxide of iron, the tint being dabbed on with a fitch, instead of being stippled. The hair of women is almost invariably auburn, inclining to red, which, however, is accounted for by the fact that the Court ladies of the period wore wigs of this colour over their natural hair.

These portraits are suggestive in the highest degree, and this is a great merit. For with enamels it is impossible to attempt actual imitation of nature. The subject can only be suggested, not reproduced. And therefore, in an art in which so much must of necessity be left to the imagination, we most highly admire the skill of the man who employs the means at his disposal, not in a futile attempt to reproduce nature, but in an effort to give rise to ideas.

There were several successors both to the Penicauds and to Limousin, and a cloud of inferior imitators; but their work calls for no special mention. It was chiefly in grisaille upon black grounds, sometimes slightly tinted, and quite wanting in the noble colour of their predecessors. When colour was used, it was ill-arranged and glaring, and usually accompanied by an immoderate use of paillon.

Of these, Pierre Raimond occupies the first place. He seems to have possessed a sort of factory, in which all sorts of work, both bad and good, were marked with his initials. He turned out sets of plates, cups, salt-cellars, and candlesticks. The grisaille work is very beautiful when it comes from his own hand. He was skilful in the use of reds and greens, and his border decorations are usually very good.

In the 17th century the art of enamellin underwent a distinct decline. The Laud family introduced the use of white ground with pictures painted on them, in horrib drawing, and gaudy red and yellow, lik painted earthenware. Raised work began to be used, by mixing china-clay with the ename and putting it on in lumps.

The atmosphere surrounding the court of Louis XIV. was not congenial to the highe forms of art. The king exercised the righ of dictating to his workmen, and when Francis I. had been content to receive in struction, Louis XIV. covered the plans of his architects with his own corrections. As a consequence, every courtier claimed to be a man of taste, and art continued to declin until towards the end of the 18th century.

In the year 1730 the art of making porcelai was discovered in Europe, and this inventio had considerable influence on enamelling Unfortunately, the first efforts of the china makers were directed to imitating the costl Chinese tea-services, which were the pride of their possessors. The unhappy tendency pro duced by the desire to rival, if not to forge the art of the Chinese has continued to ou own day, and greatly vitiated the design of modern porcelain.

The salon art of the eighteenth century i not altogether devoid of artistic merit. Con siderable skill is shown in the design, and th drawing is often very delicate; but it wa pretty art, not great art. It was endurabl when executed by artists, but it becam wretched when it fell into the hands of hack workmen, and when printed designs were sub stituted for hand work. This led to its abandon ment. The factories at Chelsea, Battersea and Bow were removed from London, and enamel upon metal ceased to be practised And it was no great pity, for the noble art had now been completely degraded, and there remained only one more depth to which it could sink, which was attained when the mode of applying it to iron was discovered, and the walls of every railway station were covered with detestable enamelled advertisements.

There is, however, one department of ename painting which is not practised at all in England now, or at all events only to a slight extent, and which is well worthy of revival. I mean the art of miniature painting upon enamel. The ground work is usually a thin plate of gold, which is preferable to copper as not being likely to stain the enamel, and bearing the heat better. The work is executed

a white ground, with fine miniature brushes, l colours similar to those prepared for nters upon porcelain. I have here a utiful little specimen of this art, which I ık it would pay to revive.

Miscellaneous.

ANCIENT EGYPTIAN GARDENING.

Vriting for the *Gardeners' Chronicle*, Mr. Percy Newberry gives the following description of dening 6,000 years ago. Although the Egyptian is extremely fertile, it is a remarkable fact t no country in the same latitude has so poor variety of indigenous plants. Wild flowers are e; native trees are few. Owing to the annual ndation of the Nile much of the land is under ter for nearly four mouths in every year; for other four months the valley is green with grow- crops, or golden with ripening corn, and the naining four months of the year the surface of soil is bare, parched and baked by the burning ı. Of natural shade there is very little. The nmonest trees that are met with at the present y on a journey up the Nile are the *Acacia Nilotica* e Sunt tree of the Arabs), the Date Palm, the im Palm, the Nebak (*Zisyphus spina Christi*), Parkinsonia, or Wild Seseban, and the Tamarisk, ne of which trees produce mnch shade. The only e of any size bearing dense foliage is the Wild g, or Sycamore (the Gimmez of the Arabs), which ows here and there in an isolated fashion. Yet if ere be a country where the cool shade of trees is quired, that country is Egypt. The native inhabit- t longs for it as much as the foreign resident, and ıring the midday heat of spring, summer and tumn, when the sky is always cloudless, the ob- rving eye will note that the fellaheen men and ys utilise every available shady corner. The cient Egyptian must have equally felt this need a cool place wherein he might take his noonday esta, and with this object in view he undoubtedly st planted trees around his house. Numberless scriptions record the prayer that a man might sit the shade of his Sycamores and "inhale the sweet, oling breeze of the north wind."

The most ancient description of a garden that ıs come down to us plainly shows that when e garden was laid out the chief object of the esigner was to make a shady place to sit in. This escription, writen in hieroglyphic writing, was dis- overed in a tomb near Abusêr, a little village not r from the modern city of Cairo. According to ıe inscriptions in the tomb, the garden belonged a certain wealthy noble named Amten, who wned several landed estates. At the outset of his career, his father obtained for him a Government appointment connected with the Administration of Provisions, and it was Amten's duty to receive, register, and distribute the meat, bread, fruits, and fresh vegetables, which in those early days constituted part of the Government taxes. While still a young man, he became Director of the Royal Flax, which meant that he supervised its culture, cutting, and general preparation for the manufacture of linen. Later in life he was appointed to the rank of a Provincial Governor, and became rich enough to build for himself a magnificent villa upon one of his own estates. Of the garden which he laid out around this villa he has left us a remarkable description, which, though brief, is nevertheless of great interest, as being by far the oldest record of a garden yet discovered. "The boundary-wall," he writes, "was 200 cubits (*i.e.*, 350 feet) in breadth, and the same in width; the garden inside it was planted with beautiful trees, and a very great pond was excavated in its centre, the surrounding garden being planted with fig-trees and vines." When the "writing for the royal rescript had been made, a very great vineyard was planted, which yielded me wine in great quantity. I trained two acres of vine hidden in the interior of the wall, and I planted trees around it."

It will be noticed that only two kinds of tree are mentioned. The first is the Fig-tree, called *dab* in this early inscription, but in later writings invariably named *nehat* or *the* tree *par excellence*—that is, the shade-giving tree of the country. The second is the Vine, called *àareret*, from a word, *àar*, meaning "to bind," "to twist round," "to twine," showing that the Egyptian name of the √ine has the same etymological sense as our European word *vinum*. In hieroglyphics a word was often written with two distinct groups of signs, one group having phonetic—that is sound—values, the other ideographic or picture-values. Sometimes these picture signs have simply a general meaning; at other times they have specific meanings. To illustrate this, let us take the ancient Egyptian name of the Lotus, or Water-Lily, which may be written in two different ways. In both examples the word is spelt out—that is, it has three sound signs—(1) a line with two strokes in the middle, which is equivalent to our *s*; (2) a rectangular sign, representing a tank, equivalent to our *sh*, and (3) a zigzag sign, equalling our *n*. These three sound-signs give the sound of the word—*seshen*. The last sign of the two examples of the word, however, differ. The three flowers attached to one stem in the first example is a general picture sign, which may be placed at the end of all flower or plant names, and merely means "a flower," or "any kind of plant:" but the sound-signs before it fix its precise meaning—that is, it is the *seshen*-flower or plant. In the second example, we see the last sign is a Water-Lily, thus proving beyond all doubt that the *seshen* was the Water-Lily. In the case o tree-names, the generic picture-sign (or determinative, as it is technically called) is a pointed tree,

somewhat like a Cypress-tree. Sometimes, however, merely a single branch of a tree is used as a determinative, though this latter sign is generally confined to such trees as supplied the ancient carpenters with good wood for building or other purposes, and not to fruit-bearing trees. The names of fruits, likewise, are determined generally by three little round balls, or a number of balls in a basket. The names of grains, also, are determined by three grains of Wheat or a number of grains in a basket. From the above-mentioned examples the reader will have obtained some idea as to the system of old Egyptian writing, and the use of picture-signs or determinatives.

In the inscription describing Amten's garden, the word for a vineyard is determined by a little picture of a Vine growing over three upright forked stakes, from between which hang two fine bunches of Grapes. This shows that the Vines were trained as at the present day in Egypt and in Italy, over stakes, so as to form a shady arbour. At Luxor, I myself had a vineyard nearly two acres in extent of this type; and in summer time, when the Vine leaves form a thick impenetrable shade, this was by far the coolest place in a well-stocked orchard and garden.

At the time of the pyramid-building kings, the Vine was extensively cultivated in different districts of Egypt, and wine-making appears to have been an important industry. In many of the tombs of this period we have representations of vineyards and scenes illustrating the process of wine-making. In the tomb of Ptah-hetep at Sakkara (15 miles south of Cairo), is preserved a series of scenes of this kind. We see first of all a gardener named Ahy watering the roots of a trellised Vine, from which two men and a boy are gathering bunches of Grapes, and carefully placing them into wicker or Palm-leaf baskets. The inscription above them reads "plucking Grapes." Following this scene is another, showing the treading of the Grapes, and it is curious to note that among them is a professional wig-maker or hair-dresser. A third scene shows the final process of wine-making, the extraction of juice from the pulp. The latter has been put into a strong bag with a loop at either end, a pole has been passed through each of the loops, and the juice is wrung out with great force by five persons. As early as 3500 B.C., six sorts of wines were made, and in the inscriptions we read of red, white, and black wines, as well as northern wine from the Delta provinces of Lower Egypt; and Sunu wine, from Grapes grown at Assuan, in Upper Egypt. One of the favourite kinds was the Amt-wine, grown in the neighbourhood of Nebesheh, a town in the Delta, some distance to the north-east of Cairo.

Another important industry in ancient Egypt was the cultivation of the Papyrus plant for the manufacture of papyrus paper. It was grown in the marshes, and there are several scenes preserved in the tombs showing the Papyrus harvest. It seems to have been chiefly cultivated in Northern Egypt, and in the hieroglyphic writing a Papyrus plant with three stalks signifies Lower Egypt, or the marshy district of Delta. The corresponding sign for Upper Eg was a Rush-like plant, perhaps some variety of Scirp

In the lists of offerings which are written upon walls of some or the early tombs, the cultivated the wild or sycamore-fig, the nebak (*Zisyphus sp. Christi*) fruit, of which a kind of bread was made, Balanites ægyptiaca, and some other fruits, are m tioned. The Onion, called hez, "the white ve table," was extensively grown, and perhaps also radish. Several kinds of grain are named, includi the durrah (*Sorghum vulgaris*), and wheat and barl The names of localities and estates were often, as w us in Europe, taken from the names of trees or plan and among these we find at the earliest histori period the "village of the vine," the "village of t barley," the "heglig (Balanites ægyptica) town," t "Fig-tree town," and so forth.

A side-light is thrown upon the gardens of t Nubians at this period from a passage in the I scription of the General Una. He tells us that one of his expeditions beyond the southern front of Egypt, he "cut down the Vines and Fig-tre of the outer barbarians." This general, accordi to his lengthy biography, which has luckily be preserved almost intact to the present time, beg his career as one of Pharaoh's gardeners. Bo late in the reign of King Unas (about 3,500 yea before the Christian era), this remarkable man te us that he wore the flower-crown of a boy courti under King Teta, by whom he was appointed the post of overseer of one of the royal storehouse at the same time acting as under-gardener to t king. Then, after serving some time as a courti and an under-priest, he was, curiously enoug appointed judge. So much esteemed was he, th he was ordered by the king to try, "alone wi the chief justice and prime minister," several in portant legal cases, because, as he naïvely tells u "the king's heart was satisfied with me mo than with any of his princes, his officers, or h servants." For the services which he re dered in this connection, he was rewarded by tl magnificent gift of a specially-prepared sarcophag and material to build a fine tomb for himself— present which may seem strange to our eyes, b was one of the greatest honours that an Egypti could receive at the hands of his monarch. Duri the time that he acted as a judge he probably still r tained his office as gardener, for he writes: "No when I was judge, his majesty made me superintende of the garden of Pharoah, and I instructed the ove seers of the garden that were there." While still comparatively young man, he was commanded by tl king to enquire into certain matters connected wi what appears to have been a conspiracy against the li of the ruler of the state. Concluding this inquiry to tl king's satisfaction, he was soon after given even mo important duties to perform than any of the precedin For the safety of the kingdom it was necessary t organise an expedition against the tribes on tl

hern frontier, and Una was sent at the head of a t army of many tens of thousands. "I it was," es the autobiographer, "who planned their pro- ıre, although my grade was that of superintendent Pharoah's garden." The expedition was success- and the General returned to Egypt covered with y, and was promoted to one of the highest ıinistrative positions in the country, the whole of ıthern Egypt from the first cataract to the Fayum ıg placed under his jurisdiction. Such was the ıtful career of one whose "grade," as he expresses was at first no higher than that of an "under dener" to Pharoah.

Notes on Books.

LEPHOTOGRAPHY, by T. R. Dallmeyer. London: Heinemann, 1899.

The main object of this treatise is to give an count of the construction, use, and applications of e lens invented by the author, and known as the Telephotographic" lens, but Mr. Dallmeyer has cluded in it a good deal of information which will of interest to photographers generally. It may leed be a question whether all the elementary struction provided will be greatly appreciated by ose who are only anxious for information about a new d useful piece of photographic apparatus, but on e whole the information is clearly given, leads up the main theme, and ought to be of service the numerous class of photographers who have ot studied optics. For instance, the chapter on The formation of images by the pinhole camera ıd its perspective drawing," though it may not ıve much to do with telephotography directly, it reshadows the difference between a fixed optical stem, such as an ordinary photographic lens, and a stem of variable focal length, one of the chief ıaracteristics of the telephotographic lens; and ırther ought to be appreciated by photographers enerally, because it discusses in a way anybody can opreciate the thorny question of "photographic erspective."

By far the simplest way is to give anybody ho has no knowledge of optics, a notion of ıe manner in which images are produced by nses, is to explain it by the action of the pin- ole camera. The simplest diagram will show im at once that if an object be placed in front f a vertical surface, and a screen pierced with a small ole be interposed between the object and the surface, ıen lines or rays starting from the top or the bottom f the object, passing through the hole, and continued o the surface, will indicate on that surface in a everse position the location of the bottom or the top f an image of the object, and that similar lines drawn from every point of the object through the hole, must fall upon the surface in such positions as to produce a complete picture of the object. Once this notion is firmly grasped, it is not difficult to see that a lens in corresponding fashion will produce a similar image.

The mystery of the production of the photographic image can thus be readily solved to the non-scientific inquirer, and, in the same way, the artist who talks in the usual contemptuous manner about the falsity of photographic perspective, may be shown that he is talking nonsense, or, at all events, using improper terms to convey what is really his meaning. All photographic perspective is absolutely correct, but it only conveys a correct impression when the picture is viewed from the proper standpoint, that is to say, with the eye placed centrally, and from a distance approximately equivalent to the focal length of the lens used in forming the picture. It is fairly obvious that if any transparent photographic picture, whether negative or positive, be held up between the eye and the actual object or scene, which is the object of the photograph, a point will readily be found at which the outlines of the photographic image correspond with and cover the outlines of the actual object or scene itself. This being so, there is probably no one who would have the hardihood to deny that the object or the scene had been correctly projected upon a plane surface, that is to say that the perspective was correct.

It will, however, in all probability be found that the point above referred to is too near the eye for comfortable or convenient vision, and in order to view the photograph with comfort, it will have to be moved to a point in which its outlines do not correspond with those of nature. This is the reason for the artistic criticism. An artist who draws a picture draws it so that it may be regarded from the point of convenient vision, a point in the case of a small drawing situated at a distance from the picture equal to perhaps two or three times the length of its longest side. This is really a much greater distance than the distance at which the photograph ought to be inspected, for probably the focal length of the lens with which it was produced, was about equal to the length of the longer side of the print.

If a photograph (the perspective of which is universally admitted to be hopelessly incorrect and out of all drawing) be simply enlarged a few diameters, the errors disappear and no one has any fault to find with it. The subject is one which cannot be pursued further in these columns, but those who have any lingering doubts may be referred to Mr. Dallmeyer's book, and after a study of it they will probably be cured of the notion that it is possible to produce incorrect perspective by optical means.

The telephotographic lens itself is merely one

by which the image of a distant object can be produced on a very much larger scale than by the use of any other photographic lens. This result is effected by the addition to an ordinary lens of a negative lens, which considerably magnifies the image. The effect is practically identical with that obtained by the ordinary process of enlargement (in which a small photographic picture is re-photographed on a larger scale) and in fact the only advantage of the new instrument is that the image enlarged is formed in the air. It has, therefore, no structure, and is capable theoretically of indefinite enlargement. As Mr. Dallmeyer says: The whole *raison d'être* for any optical enlarging system is due to the fact that the grain of the photographic image puts a limit, and a very small one, upon the number of times it can be enlarged with the requisite degree of definition.

Some very beautiful examples are given in the book, which is admirably illustrated, of the manner in which large images of very distant objects can be obtained. Of these by far the most remarkable is the well-known photograph of Mont Blanc, taken from Geneva at a distance of 44 miles. There are some other very fine bits of Alpine scenery by Dr. Spitta taken at a distance of 5 and 10 miles, and of architectural and other objects in positions inaccessible to the ordinary camera.

A perhaps rather more unexpected application of the instrument is for purposes of portraiture. The reasons for this applicability cannot here be explained. The following illustration may serve to indicate its nature. It is a common complaint about photographic portraits that the hands and feet often appear too large, or that the accessories of the portrait appear out of proportion with respect to the figure. This simply means that what may be termed the photographic point of view is nearer than the point from which we should look at the figure, or, which really means the same thing, that the photograph was taken with a lens of too short focal length to give a satisfactory rendering of every part of the picture. When using lenses of ordinary construction we may improve matters by employing lenses of greater focal length and choosing a more distant standpoint. In photographing very distant objects the telephotographic lens acts as an ordinary lens of great focal length, as above stated, but in photographing near objects it has peculiar properties of great value to the portrait photographer, in that a greater distance must intervene between a telephotographic lens and sitter than is requisite for a lens of ordinary construction of the same focal length, both images being produced in the same scale.

Further explanation of the instrument or discussion of its mode of action would occupy more space than can well be allowed to a review, but those who are interested in the subject may safely be referred to the very handsome and elaborate volume which Mr. Dallmeyer has devoted to the description of his new instrument.

A SHIRONGA VOCABULARY: or Word-Book on t[he] Language of the Natives in the District of Delag[oa] Bay. Compiled by E. W. Smith-Delaco[ur]. London: Harrison and Sons. 1899.

Mr. Smith-Delacour, who holds the office [of] H.B.M.'s Consul at Lourenço Marques, has attemp[ted] to meet the difficulty attending the intercou[rse] between European masters and native servants [in] that Portuguese district by the publication of [a] vacabulary of the Shironga language, which [is] spoken through the district. This language, wh[ich] is very mixed, has not previously been reduced [to] writing. Some of the words are taken from t[he] Zulu and Basuto languages. Others are Portugue[se], and it appears that some words have originated [in] the country. Mr. Smith-Delacour gives the p[ro]nunciation of the various words.

General Notes.

BREEDING OF REINDEER IN NORWAY.—T[he] United States Consul at Bergen reports that a co[m]pany has been formed in Irlemarken, Eastern Norw[ay], for breeding reindeer on a large scale. At the he[ad] of this undertaking is Nibs Bohnen, one of t[he] teachers in the people's high school, and for a ti[me] he will personally superintend the industry. T[he] company has already bought 2,400 deer for £1,5[00], and by degrees they will increase the herd to betwe[en] 3,000 and 4,000 deer. When this number has be[en] reached the company will be enabled to kill abo[ut] 1,000 deer every year without diminishing the he[rd]. When slaughtered a deer is worth about 30s., a[nd] there are good markets for this meat, especially [in] France and Belgium. The company also hopes [to] induce England to purchase it. In order to preve[nt] the glutting of the market during the winter month[s] a canning factory will be attached to the farm, for t[he] purpose of preserving the meat. This factory w[ill] also can char and ptarmigan. The company contr[ols] from 40 to 50 square miles of wild mountain land.

FLAX DISEASE IN BELGIUM.—The United Stat[es] Consul at Roubaix says that research into the natu[re] of the malady known as flax burn, has been made [in] the botanical laboratory of the Agricultural Institu[te] of Gembloux, Belgium, and it is now known that th[e] disease arises from a microscopic fungus growth livi[ng] in the cells of the roots and the radical hairs of youn[g] flax plants. In a circular addressed to the Sta[te] agriculturalists, M. Bryan, Minister of Agriculture, h[as] set forth the results of his researches. As the par[a]site is internal and subterraneous, there is no metho[d] of direct treatment. The use of different manur[es] has not thus far given any satisfactory result. Th[e] only remedy is to uproot the diseased plants an[d] destroy them, so that the germs shall not spread; t[o] abandon the culture of flax on the infected soil for [at] least seven or eight years; also to avoid plantin[g] turnips or colza in the soil thus abandoned, as the[se] are thought to harbour the parasite.

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l communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

On Wednesday evening, 3rd inst., Mr. ERBERT JACKSON delivered the first lecture his course addressed to a juvenile audience, e subject being "The Phenomena of Phos-iorescence."

The lecturer commenced by a reference to e natural sources of phosphorescence as en in the sea and in some cases of animal cay, &c. Phosphorescence and fluorescence ight be treated as identical terms. They ere illustrated by the exhibition of a phos-iorescent jet of steam from a vessel containing iter and phosphorus, and of the effect oduced by sprinkling fluor spar on a heated ate. He then proceeded to show how there ere certain substances which showed light, nerally of a yellowish or greenish colour, when posed to the more refrangible rays—the rays the violet end of the spectrum—and showed w the visible spectrum was apparently ex-nded in length when the violet and ultra-violet ys fell on a surface prepared with such aterials as sulphate of quinine or thallene. n passing a slab of uranium glass along the ectrum, it was made manifest that no effect as produced on the glass by the red end, hereas as soon as it was placed in the violet ys it glowed with its characteristic greenish llow colour. The phosphorescence of quinine d of fluorescein when the solution was opped into a tall jar of water was also own, and further illustrated by burning lphur in oxygen in a jar immersed within a rger jar filled with the phosphorescent solu-on. The phosphorescence of such materials ly lasted while the exciting cause was present, it there were other materials which continued emit light after the exciting light had been ithdrawn; of these possibly the best known as Balmain's luminous paint. A card coated ith this was exhibited, and it was shown how the brightness of the phosphorescence was temporarily increased by heat and diminished by cold. It was, however, possible to make other similar substances which acted in the same way, but showed light of different colours, and Mr. Jackson exhibited a fine series of phosphorescent bodies, principally lime salts, which, when excited by the brilliant discharge from a large induction coil, glowed for a certain time with various tints, blue, yellowish green, and pinkish red. Phosphorescence could be produced in a block of lime, such as that used for the lime-light, but it was of very short duration. If, however, such a block were rapidly rotated in the close neighbourhood of the induction dis-charge, the phosphorescence produced by the discharge lasted long enough to be perceived on the side of the lime turned away from the spark as it rotated. After this the lecturer passed to the phosphorescent effects produced by the electrical discharge in vacuous tubes, and showed the very beautiful results in a long tube, in which a spark from an induction coil was passed, as the air and the various gases with which the tube was filled were gradually exhausted.

The second lecture of the course will be delivered on Wednesday evening next, 10th inst., at 7 o'clock.

EXAMINATIONS, 1900.

The dates fixed for the Examinations in 1900 are Monday, March 26th; Tuesday, 27th; Wednesday, 28th; and Thursday, 29th.

The Programme of Examinations is now ready. Copies of the Programme, with full details, and an Appendix, containing last year's questions and reports by the Examiners, can be had, price 3d., post free, on applica-tion to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, W.C.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by Members on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of Members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

ART ENAMELLING UPON METALS.

By Henry Hardinge Cunynghame, C.B.

Lecture II.—Delivered November 27, 1899.

It may be perhaps permitted here to suggest certain leading characteristics which a good enamel should possess.

1. In the first place, the subject must be one that is worth representing, and must have some meaning. It is not necessary that its aim should always be moral or exalted, though, of course, the very highest art will, as a rule, be connected with, and try to express, the highest feeling. Inasmuch as the splendour and glory of colour has always been closely connected with religious ideas, enamel is peculiarly adapted for use in religious art.

2. It must next be remembered that each material has its own peculiarity, and the mark of good art is to adapt the subject to the material.

Cast iron has one use, wrought iron another, stone another, and clay another. Oil paint is capable of depth and gradation, water colour of purity and delicacy, ivory is specially fitted for delicate stippling, paper for broad washes of colour.

In enamel it is difficult to produce gradation or accuracy of tone, and there is great difficulty in the working. It has, however, two qualities that compensate for these defects, namely, durability, and a beauty of colour unapproached by any other known material.

These, then, indicate that where permanence and grandeur of colour is required, enamel should be employed, but that it is a waste of labour to use it for paint brushing of small pictures or landscapes. Therefore, pale little painted Battersea enamels, surrounded with trivial ornament, are bad art. The great characteristic of the material has been lost. Enamels should be rich, and if possible magnificent. If they have this quality we can pardon defects in gradation and in drawing, out of consideration for the difficulties of the work. For in enamel nature cannot be imitated; it is only possible to produce an effect by means of suggestion.

In some books upon composition, a great deal is made of the contrast of complementary colours. Thus it is asserted that red should be contrasted with green, and yellow with purple; but it is a mistake to attempt to mak rules of this sort. There are, of course, colou laws, but they are not of this crude description On the contrary, nothing is more beautiful tha contrasts of the same colour in different shades Blue and green make a splendid harmony.

There is, however, one observation I woul submit, and that is, that if you wish to har monise two colours that jar upon one anothe it can usually be done by putting a little each into the other. Thus, if the paint fo your wall does not harmonise with the paint fo the dado, a few tablespoonsful of each put int the other will often produce an excellent result and enamels may be toned, either by a was of some one colour over all, or else by washin a red and a contiguous blue, each with som of the other colour. They will then generall harmonise.

3. Our forefathers, among other intellectu legacies, have handed down an idea that it a gentlemanly thing to know something abo art. This unfortunate impression has produce untold evils; for too often every gentlema considers, like the marquis in the comedy, th he knows all about painting without havin learned, and is ashamed of that acknowledg ment of ignorance which is the first ste towards knowledge.

The inevitable result of this tendency is, th artistic opinions, instead of being forme slowly, with caution, and after the correctio of many mistakes, are taken, either consciousl or unconsciously, from the works upon a which happen to be in vogue at the time, an being assimilated, are mistaken by the po sessor for his own conclusions.

In consequence, while believing himself be forming original judgments, he is mere reflecting the latest artistic fancies.

At one time it will be all Correggio, at anoth the public will run mad on Burne Jones. O year the fancy will be for Reynolds and Gain borough, another will see a furore for Frenc so-called impressionism. And, therefore, whe it becomes no longer a question of admirin or trying to persuade ourselves that we admir certain well-known pictures, but of choosir wall papers, carpets, crockery, and furnitur having no principle to guide us, we fall in woeful blunders of taste.

This want of discrimination on the part the public is very injurious to true art, for artist must live, and few (at least of those wl have families) have the courage to desert the a that pays, for the art that they know to be bes Moreover, most things that are purchase

for example, wedding presents, are chosen h a view to get as much show as can be tained for the money, and this purpose is ved as well by a machine-stamped silver cup by one which has been hammered out by nd. Therefore an enameller who is resolved t to be merely a hack workman is placed at great disadvantage, for the true beauty of nd work consists in its absence of regularity, iereas the peculiar quality of machine work its mechanical precision. The English ordi-ry eye, as at present educated, desires this ecision. It loves precise repetition, such as row of cast-iron railings. It loves to see each ık of a watch-chain made so as to satisfy a icrometer-gauge, and each window of a house ı exact copy of every other. It loves perfectly nooth surfaces and exact right angles; it is e art of a nation of engineers.

To give pleasure, it is, however, necessary at there should be endless variety springing ıt of ordered regularity. The various branches the tree should be conformable to a general esign, but each twig should be different.

Nothing is more fatiguing to an artistic e than a row of spots or line which are athematically true. Then it gets as tired of em as a horse would do of a Roman road.

This is the secret why enamels in which the ırves and lines are all done by hand are so uch more pleasant than when they are drawn a ruler, and I would counsel the disuse of l mechanical aids.

4. Enamel work should be original. By this is not meant that copies of good work do not ake fine enamels. All styles, especially all yles of ornament, are characteristic of their ge, but they should not be copied or traced, ıt should be impressed on the workman's emory, and then drawn in freehand without copy. In this way they will partake of his fe, instead of being mummies. But it is most ıdesirable to try to be too original. Such iginality as comes naturally is to be welcomed, ıt striving after it has the wearying effect of person who is always trying to make jokes, ıd produces a sense of spasmodic effort which destructive to art. It is given to very few to rike out a new line, and this power only comes rare intervals.

As has been said that the various styles of ıamelling are cloisonné, champlevé, basse-ille, Limoges painted enamel, and miniature ıamels. Inasmuch as Limoges painted ıamels present the most difficulty, I shall egin with them. They are usually executed oon copper.

The copper should be very pure, so as not to melt easily, and well rolled, so that it does not exhibit any blisters when raised to a full red heat. The best is got in Paris. What is known as "Swiss copper" is also good. For small plaques, not exceeding six inches diameter, the copper may be ·35 millimetre thick, or such that one square cm. weighs ·3 gramme (in English measure this is ·014 inch thick, and corresponds to No. 28 on the Birmingham wire gauge, and a square inch weighs about 30 grains); but considerable deviation from this thickness is allowable and for larger plates the thickness should be proportionately greater. The plate must not be too thin, for then it is apt in the fire to become much bent and twisted. On the other hand, if the plate is too thick, the enamel is likely to fly. Some metals are more suitable for enamelling than others. Gold is the best, and copper and silver are next best to gold. Platinum is not good, nor is nickel. Iron is fairly good.

In order to shape the copper, the old enamellers used to place it between curved iron dies and strike it with a heavy hammer, thus stamping it into shape. The modern and more simple method is to rub it into shape with a burnisher. For this purpose a mould is provided rather bigger than will be required for the largest plate, and hollowed out concave on the lathe. It is made of a block of hard boxwood, or of several pieces of boxwood glued together, such as engravers use. Or an excellent one may be made of pewter, *i.e.*, a mixture of tin and lead. (For our purpose about equal quantities of lead and tin will do very well; this is a common sort of rather coarse plumber's solder.) It should be cast in a circular plate, about one inch thick and nine inches diameter, and then turned out in the lathe so that the section is a smooth true circle, and the centre about half an inch lower than the edges. It is better to make the mould of soft metal rather than hard, because hard metal causes every speck of dirt to make its indent on the copper plate; but if hard metal is used a soft piece of calico or thin chamois leather may be put over it. A piece of beechwood covered with brown paper will also serve. All that is wanted is a smooth uniform concave surface for the plate to rest upon.

The plate is now cut to shape with a pair of shears or strong scissors, the corners are clipped off, removing little triangular pieces about $\frac{1}{8}$th of an inch in size, and the plate is

then heated to redness and plunged into weak nitric acid and water (say $\frac{1}{8}$th of nitric) to anneal (that is to soften) it and remove the scale. The plate is then well scrubbed with water and some fine powder, such as bath brick, or powdered pumice stone, to clean it. It is then dried and placed on the mould and burnished. The burnishers used are of hematite ; good large ones should be used —the bigger the better. The stones should be well fitted into brass ferrules on the handles.

A flattened one is very convenient. A very good one may also be made out of a piece of bent steel wire, curved about to the curvature of the mould. It should be hardened, slightly tempered and polished on a leather with emery and oil, finishing it almost dry with fine emery.

The plate being on the mould, even rubbing all over with a pressure of say some 15 lb. or so will soon burnish it into a smooth bossed form like a watch glass. The curve will, if the plate is much rolled, become much smaller than that of the mould, but judicious working on the edges as well as the middle will result in the obtaining of any degree of convexity or concavity that is desired. About three or four minutes quite suffice for this operation, and once or so during the burnishing the plate should be annealed, for copper, silver and gold when rolled or rubbed become hard and resilient (or springy), whereas annealing renders them soft again.

As soon as the plate is made convex, the corners and edges have to be attended to. In the first place the corners should, with a smaller burnisher, be made a little more convex; and the edges also convexed a little all along.

The plate must now be finally annealed, for if any spring be left in it, it might fling off the enamel powder. It is now ready for cleaning. There are a great many ways of cleaning the plate—immersion in hot dilute nitric acid (1 part in 10), in hot potash solution, in hot solution of cyanide of potassium (very poisonous). Any of these are good, but the best plan is to seize it by means of a pair of tongs whose ends are made of glass, and plunge it for an instant, till it just fizzes, into strong nitric acid. It should then be rinsed under a tap and put into a dish containing water, to which some ammonia, say a two-hundredth part, has been added, to clean away all traces of acid and grease. If this has been properly done the plate will look like highly-burnished deep red gold, and may lastly be washed with clean water. Care must be taken to avoid the fumes of nitric acid, which are very poisonous. Th dipping should be done in the open air, o under a chimney.

It is a good plan to scour the plate with little pumice powder and watsr, but it is no essential. In fact, there are a hundred way of cleaning the plate, but the important part to get off completely all grease and scale, an leave no dust or grains of copper clinging to i

We have now got to cover the plate wit enamel. If the object is to make a Limoge enamel, the first coating will be black, c opaque-white, or clear transparent fondant,* or transparent colour. If the object be t make a "painter's enamel" plate, then it wi be covered with opaque-white glass.

The enamel is now to be pounded up. Fo each 8 square inches of plate about 3 grammes (1 ounce) of enamel is needful to pro duce enough to give one coat.

The enamel is placed in a very hard mortar about 8 inches in diameter, preferably o Scottish or Villon granite, with a pestle of th same material. A little clean water is poure on to it to prevent the chips from flying, an then it is pounded into small pieces with th aid of a mallet. The mortar may be laid on bag of sand to prevent its being broken by th shock. Afterwards the enamel is ground u with the pestle to the size of ordinary sea sand Iron mortars are apt to give off chips of iro scale, and porcelain mortars chips of whit porcelain, which when once in the ename cannot be got rid of, and cause specks. A magnet is of some use in removing the iron the china chips must be picked out. Hard Wedgwood ware is fairly good, but still give rise to chips. Scottish granite mortars can b made to order, but are rather expensive. The are, however, far the best.

A mortar 9 inches in diameter and 3 inche deep is very convenient. The pestle shoul have a handle 3 or 4 feet long, and the uppe part passed through a ring fixed to a bracket as was common in old-fashioned kitchens.

After the enamel begins to become small a sand, a milky substance seems to be dis engaged and to fill the water which lies abov the enamel. This consists of some of th colouring matter of very fine particles o enamel and of potash and soda. If any of i is left in, the enamel when fired will be opaqu and dull. Hence it must be washed away b

* The word "fondant" or "flux" is used for plain, whit transparent glass, this being the "foundation" of which a other colours are made.

tating the pounded enamel in water poured o the mortar and then pouring off the fluid. is must be done till the enamel remaining is fine even grains, looking like a perfectly ar, clean, fine sand. The size of the grains y be such as will go through a fine sieve h meshes 75 to the linear inch. The grains ich will pass through this would thus be out $\frac{1}{100}$th of an inch in diameter. The aterial which is washed away will amount to out half the weight employed, and should be ured into a receptacle, and will gradually ttle down into a grey mud. A plate covered th the clean clear enamel will, when fired, come transparent, but one covered with the ud will become of an opaque colour and not ry brilliant on its surface. It will be good ough for the counter-enamel. The last part grinding of the enamel should be done in agate mortar about five inches in diameter th a pestle fitted into a handle from which a rtical iron rod projects, which passes through hole in a bracket fixed to the wall. The ndle should be loaded with a weight of lead about 6 or 8 pounds.

We have now, out of 30 grammes (an ounce) enamel, got 15 grammes of fine ground ean enamel, which will cover about 8 square ches of copper, and 15 grammes of mud. e latter may have the water poured off and en be dried in a basin put upon a sand bath, else bottled up for subsequent use.

We now have to deal with the method of reading the powdered enamel upon the ate. This is usually done, and best done, th water; but there are certain weak solu- ns of gums which are indispensable for rticular purposes. They are all forms of ucilage, derived from various plants. They l contain a little resin, and on this account me of them are less soluble than others. early all of them are best dissolved by being ely powdered and wetted with alcohol, before ing put in water. The more usual forms are m arabic (mimosa nilotica); gum acacia, the st and purest of the mucilages; gum traga- nth, a thorny plant growing in Greece and e East; gum senegal, which resembles gum abic, but is more rich in resin.

Solution of Gum Tragacanth.—Wet grains of it in alcohol, and grind it up till it a thin paste, then stir it into a pint of warm ater. It is most difficult to dissolve if not ne in this way. (The corresponding amounts French measure would be $4\frac{1}{2}$ grammes of m to a litre of water.)

The next process is to coat the back of the plate so as to form the counter enamel. There are a number of ways of doing this. The simplest is to paint some gum tragacanth over the back. For this purpose nothing is better than a small tea strainer, made with very fine gauze. It should be about an inch in diameter. The plate is turned back uppermost on a small tripod placed in a tray, and gently peppered over by tapping the strainer. In this way a very smooth coat can be laid on. If it is desired to make the enamel adhere strongly to a vase or object of complicated shape, then very weak collodion may be mixed with the dry powder, and plastered on with a small knife. When dry it will adhere admirably, and on firing leave no trace. A solution of fat oil in benzine may also be employed for the same purpose if used very thin. If the gum used is too thick, then on drying it will peel off, and on firing it will either make the enamel thick and gritty or else produce upon it in the firing a scum which will spoil its lustre. All this does not much matter on the back of the plate; but it cannot be too often insisted on that where practicable it is desirable to mix the enamel powder with nothing but pure water, or else with refined petroleum, as mentioned farther on. Sometimes in grisaille work glycerine and water are used, and sometimes a little sugar candy is added to the water, but such mixtures are dangerous. It is said that the old enamellers used freshly-made olive oil with success, but the oil obtainable in this country does not seem suitable.

As the powder is dusted on from the sieve, and falls on the wet plate, it becomes darkened in colour by the moisture. The process of powdering should stop while this darker colour remains, so as to make sure that the powder is all wetted with the solution and thus made to adhere.

It is of the greatest importance that the enamel used on the back should be of the same character as that used on the front. Thus, if an enamel, say of ordinary flint glass, is used on the back, it will cause an enamel of dense flint to peel off the front. And, as will presently be explained, it is very undesirable to mix enamels of different qualities together. It can be done with careful annealing, but it is dangerous.

It is also to be remembered that the thinner the coats of enamel are the less liable are they to split or crack.

It now becomes necessary to coat the front with clean washed enamel. To do this a

small piece of board, ⅛th of an inch thick, should be provided. It should be just the size of the plate. A piece of clean dry blotting-paper is put upon it, and the plate is gently and dextrously laid upon it face uppermost, but so as not to disturb the coating on the back. The enamel mixed with water, is now dabbled on to it with a camel's-hair brush. No gum or other stuff must be used, but only pure water. The excess of water may be removed with a small piece of linen, free from fluff, or else with a small piece of sponge fastened on a stick. By putting a dry rag near the edge of the enamel the water will be sucked off all over the surface. The rag, being then made into a tompion, may be gently pressed on the enamel, which, strange to say, will not adhere to it, but will be left in a semi-dry condition. It should now, by means of a stiff, well-polished iron or steel spatula, be spread over the plate. I find that a glazier's knife makes a good spatula; a flexible palette knife is of no use—you must have something hard and very stiff. When the enamel is just in the right condition of dryness it will spread like butter, and it must be spread *and thoroughly well pressed down*, till it covers the plate in a perfectly even layer all over and *quite smooth*.

It is now ready for drying. Before it is dried, however, it must be placed upon the support upon which it is to rest in the furnace. In order that they may not bend, plates must be well supported, not only at points, but all along their edges, so that they may not sag down when heated in the fire.

For oblong plates, I find a sort of cradle made out of sheet iron very good. It should be coated all over back and front with rouge, or, better still, with equal parts of chalk (or whiting) and pipe-clay moistened with water and dried. This prevents the oxidation of the iron to a considerable extent, and the enamel will not stick to it. On this the plate is put, touching only along its two opposite edges, and having small wedges of iron pressed in at each end to support the ends, so as to prevent them from sagging when heated. If the plate is circular, a concave circular cradle may be used. The reason why the cradles are made concave is that only just the edge of the plate shall rest upon them. In this way none of the enamel on the back is removed, for the edge of the plate rests at a sharp angle with the surface of the cradle. The plate is exposed in the drying oven to a gentle heat, say 100° Fah. or 120° Fah., for an hour. Do not try and dry it too fast, which will make it peel off; on the other hand, too slow drying would allow ca bonates to form and spoil the work.

As soon as the plate is dry, the enamel w look quite light-coloured, and not a trace steam will come from it. Its dryness may tested by holding over it a piece of cold tra parent window glass, and noticing wheth any moisture is deposited upon it—in fact, j he same plan as is adopted by prudent p sons at an inn to see if the beds are damp.

The plate is now ready to be fired.

Throughout all the operations that have be described, the greatest care must be taken avoid dust and dirt. The room is best witho carpet or curtains, and if very dusty, the d should be allayed with a spray diffuser a water. Dust will be found to come in gre quantities from the operator's clothes, esp cially during the process of grinding. I ought therefore to wear a painter's canv coat. Of course, all jugs and pots should quite clean. Common blotting-paper, if us carelessly, is a great source of dusty fibre, a should never be pressed down on the enam The only proper kind to use is the dark-brov German bibulous paper used for filter paper The best rags and dusters to use are old lin rags that have been well cleaned. For pres ing down the enamels, soft old cambric excellent, and one or two rags should be ke for this, *and used for nothing else*. Son kinds of cotton are very full of fluff, and hen bad to use. Good glass cloths of linen are t best for general purposes. Every particle carbonaceous matter is apt to produce a sp by reducing the lead contained in the enam to a metallic state. A small grain of sawdu will produce in the oven a pellet of lead like small shot, for each bit of carbon is capable reducing thirty-five times its own weight oxide of lead to a metallic state.

The furnace used for heating the enam should be a muffle furnace, heated either coke or by gas. Gas furnaces of a very efficie character are made by Fletcher and Co., Warrington.

To assist in putting things into the furna and taking them out, tongs are needful. O or two sizes will do, also pincers like scisso called in French "Moustache twisters." addition to this, a bricklayer's trowel, di mounted from its wooden handle and ramm into a piece of gaspipe about two feet long, a most useful tool. For smaller pieces a chil garden spade, or a large flat palette knife, useful. A slender poker turned to a righ angled hook at the end is also serviceabl

nong other things it serves as an object to reflected from the surface of the plate, by ans of which it can be seen whether that face is glossy and sufficiently melted. A ir of housemaid's gloves of stout leather is so useful, for the hands are required to be rfectly steady, and hence must not be posed to painful heat.

As soon as the muffle is at a full red heat, must be cleansed from any sulphurous or rbonaceous fumes. This is done by blowg in air with a foot blower or a pair of llows; for carbon and sulphur are deadly emies to glass with much lead in it, and drop of oil burning in the furnace will form carbonaceous atmosphere which will cause film of reduced lead to appear on the enamel. ubsequent heating and blowing upon with bellows while in the muffle will, however, ipply enough oxygen to oxidize the reduced m, and again restore the transparency.

If the covering of the plate with enamel has een very smoothly and beautifully done, the rst firing should produce a good plate reuiring little subsequent touching up; and is is desirable, for repeated firings tend to ake the enamel shrink and to buckle up e plate, besides leaving the edges bare; but some spots or bare places occur, they should e cleaned by immersing the whole plate in cid, then well washing, and finally rubbing ith pumice powder and a brush. They should en be patched up with enamel powder, and he plate fired again. If the muffle is clean nd free from fumes, each baking improves s brilliancy.

During the firing, the enamel must be careully watched. As the plate becomes hot, the namel darkens and gradually appears as if t were sweating. This passes to an even, hiny coat, which will in the oven reflect rilliantly a piece of iron held over it. The rtist should not be too anxious to get a very mooth coating at once; subsequent firings vill gradually improve the surface.

Good work is usually *thin*. Thick coatings re liable to split. During the firing the plate, f at all nearly the size of the muffle, must be urned round once and put in again, otherwise the end nearest the door will be underired.

With large plates, and indeed with all lates, it is a very wise plan to anneal them. They may be put into the muffle at once; but n being taken out, they should be left to cool lowly in hot sand. I have even used a sand ath, heated by a gas-light gradually turned down by means of a tap attached by a string to a clock. It took twelve hours to cool the sand, and annealed the enamels excellently. As a rule, enamels will stand without annealing. This is because they are thin. By careful annealing almost any sorts of enamel can be laid one on another; without annealing different varieties are apt to crack.

The plate has now received its foundation layer, and is ready for the work.

First it will have to be determined whether any paillons or "foils" are to be used. If so, they must now be laid on. They consist of thin sheets of gold, silver, or platinum, melted into the surface, and covered with transparent enamel so as to be embedded. They give a splendid brilliancy to the superposed transparent enamel.

The thickness of metal suitable is such that a leaf of ten centimetres side should weigh half a gramme. This is about twenty-five times as thick as the thin gold used for gilding picture-frames. The gold must be absolutely pure. Excellent sheets can be got from the salesmen of dentists' material at about 4s. a gramme; that is, 2s. a leaf. Platinum is not sold by dentists' salesmen, but can be obtained for about 1s. 6d. a leaf.

The shapes of the paillons are traced out on to the sheets of paper-covered gold, and then cut out with a fine pair of scissors. The figures cut out are now placed in water, and the upper and under layers of paper allowed to float away. By this method all trouble in cutting the gold out is avoided. There should be plenty of holes—200 in a square inch are not a bit too many—and, if fine, they will ultimately be quite invisible. They are to let out the steam and air from under the paillon while it is being melted, and prevent the formation of bubbles of air or gas under the paillon.

The paillons may now be stuck in their places with some of the gum or tragacanth-water mentioned above, and well pressed down with blotting-paper. Some people like them to lie smooth, some prefer them rather creased. In the first case the gold sheets as obtained from the gold beater should have been annealed, so as to be soft. It is in this condition the dentists use them. If, however, they have not been annealed, they will crinkle a little on being put on. The smooth paillon makes the most certain and workmanlike job, the other often gives fine effects.

When the paillons have been stuck down and are dry, the next thing is to paint upon

them such shading or lines as are needed. The best substance for this purpose is black sesquioxide of iridium. If it is to be used on an enamelled surface, it may be painted on pure; but when put upon metal surface, something must be employed to make it stick. An equal quantity by weight of flux (*i.e.*, dense white flint-glass) should therefore be finely ground up with it, with water.

As soon as the shading and painting on the paillons and the surrounding enamel are done, the paillons must be fired, so as to be fused firmly down to the enamel. Judgment only can decide when the adherence is complete, but with pure gold and platinum a good firing may be given till the metal appears to be well glued down to the ground. This firing at the same time fastens down the black shading. Then, if needful, a second and reinforced shading may be given, and again fired.

The next step is to give the coats of colour. These are laid on in a state of moist powder, having been ground in the mortar, and washed as before described. The colour is laid in patches where required, and where no colour is wanted a little clear flux is put on to keep the surface even. The thinner the layers are the better. With ruby reds the colour is finest when the enamel is not ground too fine. The enamel must be well dried with blotting-paper, and pressed and squeezed and smoothed down into an even surface, just as gravel is squeezed down by a steam roller. It must then be most thoroughly dried in the drying oven, for any trace of water left under the paillons will cause bubbles, and fired till the enamel has melted. If there are any uncovered spots left, they must be covered up, and the place fired again. Colours that have been ground up on the slab with a muller will not do to lay directly on the metal; for, not being washed, they will become opaque when fired, unless they are laid so very thin as to be useless for the first covering of the metal.

By grisaille we mean a semi-transparent white, thin in some parts so as to produce shadows, and thicker where high lights are wanted. Great caution is needful in the selection of this white. What is wanted is a white which will fuse in the fire and become shiny, and yet will be so dense as not to be easily absorbed by the coating of enamel on which it lies. Flux with about 25 per cent. of white oxide of tin answers well, and is made as described hereafter. It should remain unmoved, even in the hottest fire. With unsuitable grisaille the half tones will tend to disappear, and this is quite fatal to t[he] effect.

As soon as the grisaille is finished, the ne[xt] step is the toning and tinting. This is done [by] covering such parts of the plate as require [it] with thin even coats of enamel, ground up wi[th] paraffin to an impalpable powder upon a sl[ab] of glass or of Scottish granite. Paraffin [is] much better for this purpose than water, for th[e] very fine state of pulverisation of the gla[ss] causes the water to dissolve out of it a portio[n] of the alkali. As the patch of enamel drie[s] the edges, becoming dry first, suck out th[e] alkali-laden water, and thus by degrees a so[rt] of border alkali is formed round the ename[l] like the ring of salt round a salt lake. Thi[s,] when fired, becomes a dull stain.

This undesirable effect can be avoided b[y] using a small knife of wood or ivory to scratc[h] off about sixteenth of an inch all round th[e] border of the applied colour as soon as it i[s] dry.

Gold is used with great effect upon hair, an[d] upon the high lights of garments in a manne[r] consecrated by long usage among miniatur[e] missal painters.

Sometimes it is put on in fine strokes with a very fine brush; sometimes in solid masses scratched upon afterwards with a needle.

Two sorts of gold are employed. First, tha[t] produced by precipitation of the metal from the chloride by means of iron. To do this take 1 gramme (15 grains) of chloride of gold, dissolve it in 10 c.c. of distilled water, and then add to some distilled water, a little of the gold solution and a few drops of a solution of sulphate of iron. The gold falls in a brown powder; when it has settled, put in some more gold solution and a little more iron, but take care not to have too much iron. When all has settled decant the water off, and wash by agitating it with one part of hydrochloric acid in twenty of water, to remove the iron.

Before the gold is put on, or painting done on the enamel, the plate should be well washed with methylated spirits, or with a little weak ammonia, or soda and water, and then dried with a very clean rag. Or else chalk and alcohol can be painted over it, and rubbed off when dry, just as photographic plates are cleaned. Indeed, any method may be taken that will get it perfectly clean. It is then dried and fired. The firing should be well and thoroughly done. A great deal of old work has been spoiled by imperfect firing of the gold.

Miscellaneous.

IR JOHN MILLAIS AT THE SOCIETY OF ARTS.

'he recent life of Sir John Millais* by his son tains the following interesting account of the sentation of the Society of Arts prize to Millais as oy:—"Of the occasion on which Millais received first medal, William Millais, who was present, s:—'I shall never forget the prize-day at the ciety of Arts when my brother had won the silver dal for a large drawing of 'The Battle of Bannockn.' He was then between nine and ten years of , and the dress the little fellow wore is vividly ore me as I write. He had on a white plaid tunic, h black belt and buckle; short white frilled users showing bare legs, with white socks and ent leather shoes; a large white frilled collar, a ght necktie, and his hair in golden curls. When Secretary, Mr. Cockings, called out 'Mr. Everett llais,' the little lad walked up unseen by His yal Highness the Duke of Sussex, who was giving prizes, and stood at his raised desk. After a ie the Duke observed that 'the gentleman was a ig time coming up,' to which the Secretary replied, [e is here, your Royal Highness.' The Duke then od up and saw the boy, and, giving him his stool stand upon, the pretty little golden head appeared ove the desk."

Mr. William Millais' recollections, however, require little correction, since they are difficult to reconcile th the actual facts. The first award to Millais was June the 10th, 1839, when he received the silver s medal for a "drawing in chalk from a bust." In e next year—on the 1st of June, 1840—he received silver medal for a "historical composition in pencil." looks as if Mr. William Millais had confused the o occasions—had forgotten that the first prize was ally for a chalk drawing, and had attributed to the st occasion the "historical composition in pencil"— doubt "The Battle of Bannockburn"—which ceived the second award.

It may be added that Millais was again successful the following year, for he received the Society's lver palette for a "historical composition in sepia," the 21st of May, 1841. Besides these, in 1846 he ok the gold Isis medal for an "original historical inting," and in 1847 a gold medallion for an original composition in oil."

Nor is the reference to Mr. Cockings possible. In 339 Mr. Arthur Aikin was secretary. He resigned November of that year. Mr. Cockings, who had een collector to the Society from 1772 to 1802, was ot then alive; but his place was filled by his aughter, Miss Cockings, a very energetic lady, who as entitled housekeeper and registrar, and for many years took a prominent part in the affairs of the Society of Arts. It is quite likely that she took her share in the function of the distribution of the prizes, but no doubt it was Arthur Aikin who presented the prize winners to the Duke.

The pencil sketch which Millais executed in 1840 before the judges as a test, is in the possession of the Society. It represents a battlefield with a number of figures of knights in armour. H.T.W.

* "The Life and Letters of Sir John Everett Millais." By s son, John Guille Millais.

Correspondence.

TIMOTHY HACKWORTH.

On the 8th of December, page 67, Mr. Thomas Greener placed before your readers an article setting forth the claims of Mr. Timothy Hackworth: but there are a number of very important facts to which he did not refer, and without which it is impossible to form a correct judgment.

Having on three occasions, namely, in 1874, 1892, and 1899, been professionally engaged to investigate the history of the locomotives on the Stockton and Darlington Railway, I am well acquainted with the official lists and drawings of engines built by Messrs. Stephenson, Mr. Hackworth, aud the other makers.

It must be clearly understood that the object of this article is not to advocate or disprove the claims of any inventor, but simply to direct the attention of your readers to certain proved facts which are of considerable importance with reference to the case.

In 1804, Richard Trevithick had a locomotive at work upon several occasions which had smooth wheels and ran upon smooth rails: the boiler was 6 feet in length, and contained a return flue-tube, the chimney being consequently at the same end as the fire-door: it had one cylinder, and the exhaust steam was discharged into the chimney by one blast pipe. On the 20th February, 1804, Mr. Trevithick wrote a letter to Mr. Giddy (a photograph of which I have before me), stating that the engine had been "at work several times," and that "the steam that is discharged from the engine is turned up the chimney." "The fire burns much better when the steam goes up the chimney than when the engine is idle."

On the 4th March, 1804, in another letter, Mr. Trevithick refers again to the fact that the steam is delivered into the chimney above the damper. "It makes the draught much stronger by going up the chimney."

Mr. Samuel Homfray, writing on the 10th July, 1804, reports that Trevithick's engine went down the tram-road twice after Mr. Giddy left, "with ten tons each time."

In 1808, Mr. Trevithick had another engine named "Catch-me-who-can;" it ran at a speed of fully 12 miles an hour upon a circular railway, upon the

ground where the London and North-Western Railway Company's Euston Station now stands. This engine also had smooth wheels, ran upon smooth rails, had one cylinder and one blast-pipe. Models of the two engines above mentioned are preserved at the South Kensington Museum, and should be inspected by those who take an interest in the facts.

In 1813, Mr. Blackett (of the Wylam Colliery) and William Hedley built two engines, "Puffing Billy" (now at South Kensington) and "Wylam Dilly" (now in the Edinburgh Museum). These gentlemen were well aware of what Trevithick had done, for Mr. Blackett wrote: — "If Trevithick obtained adhesion with smooth wheels on smooth rails, I can." Both these engines in 1813 were fitted with two blast-pipes, one for each cylinder, and it was on account of the "puffing" noise caused by these "blast-pipes" that the first engine was known as "Puffing Billy."

Towards the close of the year 1813, George Stephenson designed and commenced the construction of his first engine, and it was completed and ran its first trip on 25th July, 1814, and it was named "Blucher." One of the partners in the Killingworth Colliery, where George Stephenson was employed, had himself ridden up Trevithick's engine in London in 1808; he was therefore well aware that "smooth wheels had the necessary adhesion upon smooth rails." George Stephensons's engine, therefore, had smooth wheels, and two blast-pipes, one for each cylinder.

In 1812, Mr. Blenkinsop had an engine running on his Middleton Colliery line, near Leeds, in which the exhaust steam from two cylinders was discharged by one pipe into the open air; but four years later, 1816, he extended this pipe, and had one blast-pipe turned upwards in the centre of the chimney for both cylinders, the result being that the speed of the engine was doubled and its load increased. This engine was named "Blenkinsop," after the owner.

Between 1814 and 1825, George Stephenson had built sixteen locomotives, all fitted with two blast-pipes; and, in the year 1825, Robert Stephenson and Company built the "Locomotion" for the Stockton and Darlington Railway. It also had two blast-pipes when new, worked with the two until the year 1841, and still has them now at Darlington.

In 1826, Messrs. Stephenson and Co. built three more engines for the Stockton and Darlington Railway, named "Hope," "Black Diamond," and "Diligence." They were made to the same drawings as "Locomotion," and had two blast-pipes.

Messrs. Wilson and Company, in March, 1826, placed a four-wheeled four-cylinder engine, named "Stockton," upon the Stockton and Darlington Railway. In this engine, each pair of wheels was perfectly independent, being actuated by a pair of cylinders, the crank-pins being at right angles to each other. Steam could be applied to either or both pairs of cylinders at pleasure, and the two sets of valve-gear could be reversed independently. The exhaust steam was discharged into the chimney by two blast-pipes, one for each pair of cylinders. [...] engine, having run for a few months, came [...] collision at Stockton, when the four cylinders an[...] the over-head gear was smashed, and the official [...] dated 31st December, 1826, states No. 5 "[...] engine is not now in use."

In October, 1826, Messrs. R. Stephenson and [...] placed a new engine upon the Stockton and Darl[...]ton Railway, named "Experiment," No. 6 in [...] books of the railway company, and No. 9 in [...] books of the firm. This engine ran upon six wh[...] all coupled together by rods, the cylinders be[...] placed outside and inclined, the connecting-rod w[...]ing direct upon the crank-pin of the leading wh[...] the exhaust steam was discharged into the chimne[...] two blast-pipes. A drawing of this engine appe[...] on one of the large locomotive diagrams at the So[...] Kensington Museum. The "Experiment" was [...] first locomotive ever built having six wheels coup[...] by rods, it worked successfully for several years, [...] as shown by Mr. Nicholas Wood, Third Edition, [...] 736, during the second half of the year 1833 it r[...] 4,400 miles; the cost of repairs per gross ton carri[...] one mile on a level was 0·053 of a penny.

After the "Experiment" had been at work [...] twelve months Mr. Timothy Hackworth placed t[...] "Royal George" upon the Stockton and Darlingt[...] Railway, being the old No. 5 "Stockton" rebui[...] Mr. Hackworth converted Wilson's four-wheel[...] engine to six wheels all coupled, placed a return tu[...] in the old boiler, and removed the four brok[...] cylinders and adopted two. The old engine had o[...] blast-pipe for each pair of cylinders, aud Mr. Hac[...]worth retained the same arrangement for the new p[...] of cylinders. In 1828, Messrs. Stephenson and C[...] constructed a four-wheeled ballast engine nam[...] "Lancashire Witch," being No. 11 in the books [...] that firm; it was provided with the two blast-pipe[...] one for each cylinder.

This engine was put to work to remove material [...] the making of the Bolton and Leigh Railway, t[...] length of rails upon which it ran being less than 3[...] yards. With such a short run, and having to wa[...] for some time together without moving, there w[...] much trouble in maintaining steam. To overcom[...] this trouble a pair of bellows was fixed under th[...] tender capable of being worked by a hand-lever, an[...] air was forced through the fire from the under sid[...] The bellows were only in use to maintain steam whe[...] the engine was standing still; when running the tw[...] blast-pipes maintained steam. The bellows, as Mr[...] Stephenson expected, overcame the difficulty, but a[...] soon as the line was opened, and there was a prope[...] length of run, they were no longer required; however[...] they remained under the tender for over 15 years[...] although the lever and its eccentric were taken off.

In 1829, R. Stephenson and Co. built th[...] "Rocket" (No. 19 in their books) for the trial a[...] Rainhill. It had two blast-pipes when it left th[...] works at Newcastle, each blast nozzle being $1\frac{1}{2}$ inch[...] diameter, giving a draught equal to 3 inches of wate[...]

sure. It worked with the two blast-pipes until 3-4, and still has them at the South Kensington seum; and it may be added that both the ocket" and Mr. Hackworth's "Sanpariel" now d upon original Liverpool and Manchester rails 829, presented to the Museum for the purpose by writer.

he books of Messrs. R. Stephenson show that ween 1824 and the close of the year 1829, the firm built 19 engines, all having two blast pipes. ly in the year 1830, when the "Invicta," No. 20, completed for the Canterbury and Whitstable ilway, the exhaust was turned into the chimney by blast pipe; this engine is preserved by the South-stern Railway Company, and is illustrated at uth Kensington. The whole of the drawings of early Stockton and Darlington engines, together h the official locomotive lists of that Company and Messrs. Stephenson, formed a portion of the tretton Collection" at the Chicago Exhibition of 93, but to further quote them would unduly extend s article.

CLEMENT E. STRETTON, C.E.

Obituary.

SIR JAMES PAGET, BART., F.R.S. — This dis-guished surgeon, who died at his house in Park-uare West, Regent's-park, on Saturday night, cember 30, was a member, and in 1884 a vice-esident of the Society of Arts. He was born the 11th of January, 1814, at Great Yarmouth, ere his father, Mr. Samuel Paget, was a mer-ant. He was a student at St. Batholomew's ospital, and obtained almost all the prizes that re then given. In 1836, he became a member the Royal College of Surgeons, and was ap-inted demonstrator of Morbid Anatomy at the spital. He was soon promoted to be lecturer on eneral and Morbid Anatomy and Physiology, and 1843, when the Fellowship of the College of irgeons was established, he was one of the en nominated by the Council as Honorary Fellow order to constitute the grade. He was suc-ssively assistant-surgeon, full surgeon, and con-lting surgeon to his hospital. He was appointed rgeant-Surgeon to the Queen in 1877, and he as also surgeon to the Prince of Wales. He filled e office of President at the College of Surgeons, d at most of the great medical institutions of ondon, and was Vice-Chancellor of the University London from 1884 to 1895. He was created a ronet in 1871, and he received honorary degrees om the Universities of Oxford, Cambridge, Edin-rgh, Dublin, Bonn, and Würzburg. He was also corresponding member of the Institute of France. r James Paget's fame as a lecturer and as a speaker as equal to his distinction as a surgeon and a man science.

ADMIRAL SIR FREDERICK NICOLSON, BART., C.B.—Sir Frederick Nicolson, the 10th Baronet, died Friday, December 29th last. He was born in 1815, the son of Major-General Sir William Nicolson, by the daughter of Mr. John Russell, granddaughter of Robertson, the historian. He succeeded his father in the baronetcy in 1820. Sir Frederick entered the Navy in 1829, became lieutenant in 1837, commander in 1841, captain in 1846, and vice-admiral in 1870. He was commodore-superintendent of Woolwich Dockyard 1861-64, and became rear-admiral of the blue in 1863. He retired in 1873, and became admiral (retired) in 1877. He was for some years chairman of the Thames Conservancy Board, and frequently joined in the discussions at the meetings of the Society of Arts on water supply and the treatment of the Thames. He was elected a member of the Society in 1873, and was a member of the Council from 1880 to 1882.

MAJOR-GENERAL GEORGE HUTCHINSON, C.B., C.S.I.—General Hutchinson, who died December 30th, was a member of the Society since 1895. He entered the Bengal Engineers in 1844, and served with the army of Sutlej, 1846. In the Indian Mutiny, as political A.D.C. to Sir Henry Lawrence, he was in charge of a movable column before the siege of Lucknow, and in various offices of import-ance throughout the siege and after. He was military secretary in Oudh during the suppression of the rebellion. He entered the Bengal Staff Corps, and became chief of police in the Punjab. He reorganised and commanded the new force, 1861-75, and was mentioned in despatches, being specially reported by the Governor-General. He received a special letter of approbation by the Queen, and the medal with two clasps. For seven years he was lay secretary to the Church Missionary Society, on whose committee he continued to act, as well as on that of the British and Foreign Bible Society.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

JANUARY 17.—"Ventilation without Draughts." By ARTHUR RIGG.

JANUARY 24. — "Local Government and its re-lation to Parish Water Supply and Sewerage." By W. O. E. MEADE-KING, M.Inst.C.E. SIR BENJAMIN BAKER, K.C.M.G., will preside.

JANUARY 31.—"The Undeveloped Resources of the Bolivian Andes." By SIR W. MARTIN CON-WAY, M.A.

FEBRUARY 7.—

FEBRUARY 14. — "The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD.

FEBRUARY 21.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S.

Indian Section.

Thursday afternoons at 4.30 o'clock:—

January 18.—"Our Work in India in the 19th Century." By Sir William Lee-Warner, K.C.S.I., M.A. The Right Hon. the Lord James of Hereford will preside.

February 8.—"New Projects of Railway Communication with India." By James Mackenzie Maclean, M.P. Lord Edmond Fitzmaurice, M.P., will preside.

March 29.—"The Manufacture and Use of Indigo." By Christopher Rawson, F.I.C.

April 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By Sir John Scott, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

May 17.—The Industrial Development of India." By Jervoise Athelstane Baines, C.S.I.

[The meetings of January 18, February 8, and May 17 will be held at the Imperial Institute.]

Foreign and Colonial Section.

Tuesday or Thursday afternoons at 4.30 o'clock:—

February 1 (Thursday).—"The Century in our Colonies." By The Right Hon. Sir Charles Wentworth Dilke, Bart., M.P.

February 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. Hedger Wallace.

March 20 (Tuesday).—"Imperial Telegraphic Communication." By Sir Edward A. Sassoon, Bart., M.P.

Applied Art Section.

Tuesday evenings at 8 o'clock:—

January 30.—"Niello Work." By Cyril Davenport.

February 13.—"The Best Means of Arresting the Decay of Indian Art." By John Sparkes.

March 13.—"English Furniture." By Lasenby Liberty.

April 3.—"Process Engraving." By Carl Hentschel. William Luson Thomas will preside.

Cantor Lectures.

Monday evenings at 8 o'clock:—

Bennett H. Brough, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

Lecture I.—January 22.

Deposits in which ores of the useful metals are met with—Beds, veins and masses—Classification of ore deposits—Methods of mining formerly employed—Recent improvements.

Lecture II.—January 29.

Sources of the world's supply of gold and silver—Principal mines now worked—Future resources.

Lecture III.—February 5.

Sources of the world's supply of iron or Principal mines now worked—Future resources.

Lecture IV.—February 12

Sources of the world's supply of copper or Principal mines now worked—Deposits of the of lead and other metals.

*** Lectures illustrated by lantern photographs

E. Sanger Shepherd, "Photography Colour." Four Lectures.

March 5, 12, 19, 26.

MEETINGS FOR THE ENSUING WEE

Monday, Jan. 8...Mechanical Engineers, Storey's-gate, James's-park, S.W., 7½ p.m. (Graduates' Me ing) Mr. H. H. Mogg, "Treatment of Sew and Sewage Sludge in Rural Districts."
Chemical Industry (London Section), Burlingt house, W., 8 p.m. 1. Mr. J. W. Hinchl "Colour Photography." 2. Mr. J. M. Var Vergara, "Cinchona." 3. Mr. R. M. Pridea "Microscopic character of Vicunna, Camel-h and Alpaca."
British Architects, 9, Conduit-street, W., 8 p.
Camera Club, Charing-cross-road, W.C., 8½ p. Mr. L. Howie, "Five European Capitals."
Medical, 11, Chandos-street, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 4 p. (Juvenile Lectures.) Mr. A. H. Fison, "S Colours and London Fogs."

Tuesday, Jan. 9...Royal Institution, Albemarle-stre W. (Juvenile Lectures.) Mr. C. Vernon Bo "Fluids in Motion and at Rest." (Lecture VI.)
Medical and Chirurgical, 20, Hanover-square, W 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., p.m. 1. Mr. Reginald A. Tatton, "The Purific tion of Water after its use in Manufactories." Mr. W. O. E. Meade-King, "Experiments on t Purification of Water from Factories."
Photographic, 66, Russell-square, W.C., 8 p.
Anthropological, 3, Hanover-square, W., 8½ p.
Biblical Archæology, 37, Great Russell-street, W.C 8 p.m. Annual Meeting.
Asiatic, 22, Albemarle-street, W. 3 p.m.

Wednesday, Jan. 10...SOCIETY OF ARTS, John-stre Adelphi, W.C., 7 p.m. (Juvenile lectures.) M Herbert Jackson, "The Phenomena of Pho phorescence." (Lecture II.)
Geological, Burlington-house, W., 8 p.m.
Royal Literary Fund, 7, Adelphi-ter., W.C., 3 p.m.

Thursday, Jan. 11...Antiquaries, Burlington-house, W 8½ p.m.
Electrical Engineers, 25, Great George-street, S.W 8 p.m. Report of the Institution's visit to Switze land. The Report will be taken as read, and th discussion will be opened by Mr. Crompton by comparison between British and Continent practice in Electrical Engineering.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Friday, Jan. 12...Civil Engineers, 25, Great George-stree S.W., 8 p.m. (Students' Meeting.) Prof. Claxton Fidler, "The Theory of Structures an Strength of Materials."
Astronomical, Burlington-house, W., 8 p.m.
Philological, University College, W.C., 8 p.m.
Clinical, 20, Hanover-square, W., 8½ p.m.

Saturday, Jan. 13 ..Botanic, Inner Circle, Regent's-park N.W., 3¾ p.m.

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FRIDAY, JANUARY 12, 1900.

l communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

JUVENILE LECTURES.

On Wednesday evening, 10th inst., Mr. ERBERT JACKSON gave the second and st of the juvenile lectures on "The Phe- omena of Phosphorescence." In this lec- ire, Mr. Jackson dealt principally with iosphorescence, produced by means of the ectric discharge in tubes exhausted to a ery low pressure.

The lecture commenced with an illustration the passage of an electric current through ases. Air, hydrogen, argon, and helium ere shown, and their different spectra referred . It was suggested that the light in these ases could be considered as closely related to iat given out by solids made to phosphoresce nder electrical excitation. The attraction of ith balls towards a piece of electrified sealing- ax, and their subsequent repulsion after uching the wax, was shown as a rough lustration of the idea that the particles of a as might be considered to be first attracted , and then repelled from, an electrode t high potential. Such particles might be iought of as rapidly traversing the space in partial vacuum between the electrode and he phosphorescent substance in a state of tatical charge. When they reached the ubstance they were discharged, the oscil- ations set up at such a moment gave ise to rapid movements in the particles f the solid to which the phosphorescence ould be ascribed. Examples of such phos- horescence in high vacua were then shown, nd the nature of the phosphorescent light tself was next considered. The spectra of alcium and strontium, either from their salts n a flame or in the electric arc, were described nd shown, and then specimens of phos- horescent lime and strontium compounds vere exhibited to illustrate the idea that the low from them was closely related to their spectral colours. In some the red part predominated, while in others the orange, green, or blue were most marked, the result being that some specimens of lime gave red, some orange, some green, and some blue phosphorescence, and apparently in equally pure specimens. It was then shown that the phosphorescence induced in such specimens was the same, whether light or electricity were used as the exciting cause. This was done by exposing them to the light of a jar spark and intensifying the glow by heat. Thus lime, which gave an orange glow when excited electrically, yielded a similar colour when dusted over a hot-plate after exposure to actinic light. So also for green and blue glowing limes.

The response of barium platinocyanide to X-rays was shown, and the effect of sudden discharge, which might, perhaps, be considered to give rise to pulses rather than periodic undulations, was illustrated by two globes, each containing only one internal electrode. In one the external electrode was an acid solution of quinine, which phosphoresced more brilliantly when a spark was allowed to pass, so as to afford a path for the discharge of the whole system as a Leyden jar. In the other, the outside electrode was tinfoil, and sticks of lime were inside the globe. These sticks were shown to glow brightly as soon as a path was made for the oscillations of the globe as a jar.

At the conclusion of the lecture, a unanimous vote of thanks was passed to Mr. Jackson and his assistant, Mr. Laurie, on the motion of Professor J. M. THOMSON, F.R.S., who occupied the chair.

CANTOR LECTURES.

The absence of Major Cardew from England will prevent his fulfilling his engagement to deliver a course of lectures on the "Supply of Electrical Energy" before the Society; but the Council are glad to be able to announce that Professor James A. Fleming, D.Sc., F.R.S., has undertaken to deliver a course on "Electric Oscillations and Electric Waves," to be given on May 7th, 14th, and 21st.

COVERS FOR JOURNAL.

For the convenience of Members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

ART ENAMELLING UPON METALS.*

By Henry Hardinge Cunynghame, C.B.

Lecture III.—Delivered December 4, 1899.

Cloisonné enamel is usually employed for jewellery, and done with gold. Pure gold is known as "fine gold." Gold is alloyed with silver or copper; the amount of alloy is expressed by the number of parts of fine gold in 24. Thus 18 carat gold means gold to which a quarter of its weight of silver or copper has been added. Fine gold is very beautiful, but very soft. It is never employed now for jewellery. I would advise nothing else for enamelling, as it resists the fire admirably, and however heated does not blacken, whereas gold with even 1 per cent. of alloy tarnishes with the fire or with exposure to the air. When covered with enamel, fine gold becomes quite stiff enough for ordinary use. Gold may be cleaned by heating it and plunging into it nitric acid. It then takes a splendid yellow tone. It should be left a little time in the acid, then rinsed with plenty of clean water, and finally dried in hot boxwood sawdust. Jewellers are obliged, from motives of economy, to use alloyed gold for enamelling, but it sometimes melts or softens in the furnace, and its use often leads to disappointment. When heated, all kinds of alloyed gold or silver come out black from the furnace, but pure gold and silver come out quite clean and unoxidized.

In the manufacture of jewellery the first essential operation is soldering. To solder two pieces of metal together, an alloy is used which melts more easily than either of them. It is a well-known but unexplained fact that alloys melt at a temperature less than the metals of which they are composed. Thus, if some common solder, composed of lead and tin, is heated to a temperature much less than that of copper, it will amalgamate with and melt into the copper. For this purpose, however, the copper must be perfectly clean. To clean it, mere scraping with sand or emery paper is not enough; for the heat would cause oxidation, and thus continually recoat it with oxide. We need, therefore, a solvent for the oxide which shall not be driven off at the soldering heat.

* These Lectures are Copyright.

For soldering brass, copper, or tinned iron solder is used composed of lead and tin, call plumber's solder, and made hard, *i.e.*, one le to two of tin; medium, and soft, *i.e.*, one le to one of tin. The copper or brass is w cleaned, and then covered with a little res or else with liquid chloride of zinc, often mix with sal-ammoniac. When heat is applie the water in which the chloride of zinc and sa ammoniac are dissolved is driven off, and t salts then fuse into a liquid state, in whi condition they powerfully dissolve the oxid on the metals, and allow the solder to adher

But plumber's solder is weak, and wou never do for jewellery, because any trace lead in or upon gold instantly permeates de into the metal, and renders it brittle. W thus require a harder solder. This is to b found by mixing gold with silver, copper, brass.

Here, however, we are presented with fresh difficulty. The brass or silver is volatil and at a great heat might be driven of Again, the chloride of zinc and sal-ammonia that answered as fluxes at the low temperatu of plumber's solder, must be replaced by som solvent which better resists heat.

The danger of volatilisation of the mor volatile parts of a solder is guarded agains by heating the work well before the solder i put on, and a convenient flux is found in borax

There is, however, yet another danger. I a small piece of gold is to be soldered t a large piece the small piece gets heated first for its surface being large in proportion t its bulk, it absorbs heat rapidly. In con sequence, the solder rushes off to the sma piece and bathes it, leaving the larger piec dry.

Moreover, borax presents difficulties, for it contains a great quantity of water of crystal lisation, which causes it to bubble up whe heated, and dislodge the work, and burs open joints in which it has been put. These difficulties may, however, be got over.

First, as regards the borax, if it is melted (so as to drive off the water) into a brittle glass, and then finally ground up to an impalpable paste with the petroleum which has been described for use with grisaille, it will give no trouble by bubbling. I believe this plan is new, and it is certainly effective.

In the next place, care should be taken to heat the larger pieces first. Thus, if a very small bit has to be soldered on to a large thin surface, the heating should be done from the back of the bigger piece.

Again, if the joint to be made is large, it l perhaps be possible to heat the work first, then, when it is red-hot, to put the der on, and suddenly re-heating it to use the solder to run before it has time to come volatilised.

If part of the work is very thin, and in nger of being melted, it is possible to pro- t it with a layer of fire-clay. For this pur- se plaster of Paris mixed with four times bulk of tripoli powder answers admirably, rming a paste, easy to scrape off, but per- ctly unalterable by the fire.

The volatilisation of the solder may also greatly hindered by hammering it well fore use, and using it in as large bits as ssible. Only just enough solder should be nployed to make the joint, for otherwise it ns over the gold and spoils its appearance. esides, there is a danger of its becoming corporated with the gold, and causing holes be melted in the work. Hence, then, we ave the following rules. Clean the work ell; use borax, ground in petroleum. Do ot put the solder on in too small pieces, ut let them be as reasonably large as pos- ble. Use as little solder as you possibly an. Avoid playing the flame, if you can, n the solder, but rather play it well on the igger parts of the pieces which are to be ldered. If the work permits of it, heat it efore you put the solder on, and cover up e more delicate parts by a paste of fire- lay or some preservative substance.

When solder is melted, if it is suitable for e work in hand, it is very adhesive, running y capillary attraction over everything, and rawing joints together. If the softer metal it becomes volatilised it will not run, but rms into little globules, and spoils the work.

A suitable solder for any sort of gold is the old itself alloyed with one-sixth of its weight f silver. Fine gold can be conveniently oldered with 18 carat gold.

If the work is to be enamelled, the solder nust not be too fusible, as it would melt in the eat. Any soldered parts of the work that are o be exposed to the heat of the furnace and re not enamelled, must be protected with a overing of clay.

For copper or brass, a solder composed of parts of silver and 1 part of the finest brass got out of brass wire) is employed. Or, again, qual weights of copper and silver coin can be sed. It is a little harder than the last. But t is not economical to make solder out of coin, or the metal in a shilling is only worth seven- pence. The zinc in the brass greatly assists the fusibility of the solder.

Gold is one of the most malleable metals known, and may be twisted, or hammered, or rubbed into any shape. But a very little working makes it hard, and it then needs annealing, that is to say heating to a dull red, and then allowing it to cool. It is best not to plunge it into water (a process which improves the annealing of copper). The gold must be repeatedly annealed. At first every two or three minutes is not too much.

As soon as the work has been hammered, and bent, and rubbed approximately into shape, finer work can be done by backing the gold upon a lump of melted pitch, and when it is cool, working upon it.

A few lessons upon this part of the art can be got at any technical school.

When finished, the article can be cleaned in warm dilute nitric acid, well washed, and then burnished. But fine gold must only be used for necklaces or lockets, or articles which will not be subjected to much hard wear.

For cloisonné work, both the foundation and cloisons should be made of fine gold. It is necessary to have a small draw plate made with a very fine rectangular hole.

Fine gold wire should be annealed and drawn through this hole. It will then become proper for cloisons. Of course, thicker or wider wires might be used if desired. Very pretty cloisons are sometimes made by twisting together two wires into a rope, or with the crinkled wire used by makers of filigree work. This does not seem to be employed in England, but may be procured in Geneva.

This wire is then bent to the shape of the cloisons, placed in position, and the junction with the gold foundation slightly touched with a fine camel's-hair brush moistened in the borax and petroleum preparation. Little bits of fine wire solder (18 carats) are then put in so as to lie close to the cloisons, and a mouth blowpipe with a Bunsen or alcohol lamp will soon melt the solder; or, if possible, it is better to use a larger blowpipe, and heat the work from the back. It is better to put the cloisons on not too many at a time, because mistakes are thus more easily rectified.

It would be fatal, of course, to use plumber's solder for this purpose, as the lead would at once eat the gold into holes. In fact, if any lead gets into contact with gold, it must by no means be heated (which would only alloy them the more), but must be at once dissolved away with warm nitric acid.

Nor, again, for enamelled work is it wise to use solder of less than 18 carats, for poorer solder is also apt in the furnace to eat the gold into holes.

As soon as the gold work has been completed, any roughness may be removed with a scraper or the file.

Beware, however, of attempting to get the piece too smooth. An affected rudeness of work is of course offensive, like the mannered slobbering of a certain school of modern painters. But, on the other hand, affected neatness takes all the character out of the work, and makes it of the "tea-tray" order. It should be neither horribly bristling with rough edges, nor smoothed down like a piece of modern Birmingham jewellery. It is difficult to work with very thin gold. The best thickness is about ·02 inch.

As soon as the gold work has been completed, and well pickled in nitric acid till it is of a splendid colour, the enamel may be laid on.

It must be very finely powdered, well washed, and laid on with a small spatula, or else a brush.

It may then be fired in a large alcohol flame or else in the muffle furnace. But it must not be put into a gas flame of any sort, as the sulphur would reduce the lead and blacken the enamel.

In the furnace the work must be propped up on all sides with small pieces of thin iron, painted over with whiting (or chalk, which is the same thing) and pipe-clay. Of course, it should only rest on sharp points of iron, so as to leave as few marks as possible.

Instead of soldering the cloisons down, they might have been stuck down with celluloid in acetate of amyl, or with collodion, and then the melted enamel would keep them in place. But this plan is not a good one, because at each reheating they all become loose, and may shift their position.

Small sham jewels can easily be made by putting on little circles, losenge shapes or ovals, of cloison, and then filling up brilliant transparent enamel on them, and fixing it so that it projects like a sort of drop. It then looks like an uncut stone. Such ornamentation is legitimate if it is not made to impose on the spectator, but real jewels are preferable. They are very easy to fix by bending strips of cloison to serve as cells, and soldering them on; and then, when all the enamelling has been done, the stone is slipped into its cell, and the edges of the cell burnished down over it with a small hardened steel burnisher. Lit pearls are often hung from such work by mea of gold wire.

The enamel may be loaded on till it projec above the cloisons, and then the surface grou over with an emery file and water, and fina polished, first with pumice powder and wat and then with rotten-stone. But such work h rather a tame and smooth appearance.

Of course, if preferred, the enamel can l laid on over the jewellery without any cloison Most effective work can be done in this wa Fine gold, when covered with flux, takes colour so vivid as to be almost too powerfu Its splendour must be seen to be appreciate and it generally needs toning to be endurabl

Silver work is similarly executed, excep that the pickle for silver should be dilut hydrochloric acid, and as it is soft, great car is needed in firing. But with blue and gree colours, enamelled silver gives splendid effects Reds and yellows do not harmonize so we with it.

Parti-coloured work is also effective, especially in making small coats of arms fo lockets, but it must be used with discretion i order not to look vulgar.

In fact, as a general rule in making jewellery, the necessity of restraint cannot too ofte be insisted on. A mass of tiny brilliants is a beautiful thing, whereas the Koh-i-nûr is lik an ugly lump of glass.

By grinding up old broken china with hal an equal weight of flux, a clay can be made which, in the fire, will set like porcelain, and can be afterwards enamelled, and then painted.

The royal blue beads found on mummies can be easily imitated in this way. The blue enamel must be roughly laid on, and is made out of cobalt glass with a very slight admixture of green-copper glass. The markings on it are then made with flux, oxide of iridium and cobalt. White enamel for the same purpose can be made out of the ordinary flux and tin. Most curious necklaces can thus be made.

If care is taken in the annealing, ordinary china or porcelain can be beautifully ornamented with enamel and gold. The soft enamels used on metal are admirable for this purpose. They may be ground with water or petroleum and laid on.

A good plan for making gold enamelled book-covers, or indeed any form of ornament, is first to model a design in modelling wax, then take a plaster cast of that, and then a cast of that again in ordinary pewter, to which

ittle antimony has been added to harden it. better still, take an electrotype of it, well cked with hard solder. Then take a sheet fine gold, of from about $1\frac{1}{2}$ grammes (one nnyweight) to the square inch on it, and, th repeated annealing, burnish it well on to metal mould, which should previously be ped over with grease and blacklead to event the gold from sticking; then melt it to pitch, and finish it up with a pointed rnisher. This, if enamelled in transparent amels, will have a brilliant effect. The ly fault will probably be that it will be too lliant, but that fault can easily be corrected toning it with darker enamels ground in troleum as described elsewhere. Silver may similarly treated, but should be rather icker. Beware also of silver-soldered joints; ey are very apt to eat into holes when amelled. The different parts can, after ing enamelled, be easily stuck together by eans of enamel, which forms an excellent lder for them.

In all the above work I strongly advise the e of nothing but fine gold, or at all events old over 20 carats. I also recommend the nateur not to try and imitate modern work, it to go to the British Museum and study old reek, Assyrian, Egyptian and Celtic jewelry, and then design something in those yles; or better still, with the inspiration rived from the contemplation of these, try d design something modern. The work ill look splendid if fine gold is used, well ckled in nitric acid. Some little care must, owever, be taken not to expose the enamel to o strong acid, as there are some colours, otably browns, which it will decompose. If it wished to remove enamel you have only to eat the object to a low red and plunge it in old water. If this is done several times the namel will crack off.

Fine gold may be burnished with an agate urnisher and cleaned with a little alcohol, utty powder, and a soft brush. Enamel may filed into shape with an emery stick. If it is en washed over with hydrofluoric acid and ed it will again become quite brilliant, or it n be polished with fine emery, followed by tten-stone, and last of all rouge.

For very dirty jewellery make up a paste with ap, and 5 per cent. of rouge for hard metals, putty powder for soap. This soap, used ith a brush and warm water, will clean things xcellently, and, curious to say, rouge-soap eans the hands in a most extraordinary anner. But dirty hands are best cleaned by a good rubbing with vaseline, and then washing with soap and water.

It is unfortunate, as has been already remarked, that electrotypes cannot be enamelled owing to the occluded air they contain. It is, however, possible to employ them indirectly. Thus, if a jewellery design be executed in modelling wax on a piece of glass it may be well rubbed over with a little plumbago, or better still, with the special bronze powder sold for that purpose. The best copper-coloured bronzing powder answers well. It may then be electrotyped by arranging a bath with a half-saturated solution of nitrate of copper, to which about a thousandth part of sulphuric acid is added. The current should be about one-fifth of an ampere to the square inch. In two or three hours the electrotype will be finished. It should then be "backed" by rubbing the back over with a little chloride of zinc, and then filling it in solid with melted solder. A piece of pure sheet gold weighing about a gramme (*i.e.*, $15\frac{1}{2}$ grains) to the square inch (that is to say, about twice the thickness used for paillons for Limoges enamelling) may now be squeezed and burnished over it, and hammered into the hollows with little plugs of soft wood. The gold should be *repeatedly* annealed, and if the burnishing is well done an exact copy can be taken of the electrotype with every scratch sharply marked. Most beautiful impressions of medals may thus be made. All that is wanted is patience and plenty of annealing.

These may then be enamelled, back and front, with transparent enamels. Little heads, ships, and other objects can be made by modelling them in wax, then making a mould in plaster of Paris, and then a cast in fusible metal, composed of lead, tin, and bismuth, say equal parts of each. This should be well brushed over with plumbago. The gold can then be burnished on to the cast, worked with stamping and embossing tools, and then enamelled both inside and out. If any lead sticks to the gold it must be at once dissolved off with nitric acid. This is a good way to make handles to cups or jewellery of all sorts. The gold is plastic to an extraordinary degree, and if only repeatedly annealed can be moulded and stretched like wax.

Electrotypes can be taken straight from copper medals if care is taken to coat them well with plumbago and alcohol, and then when the coating is dry to brush off the plumbago with a soft brush. An exceedingly thin film of plumbago is always left, which prevents the type from sticking. Of course, valuable medals

must not be treated in this way. The electrotypes thus obtained can be used to obtain gold "squeezes," which in their turn can be enamelled.

Imitation intaglios can also be produced, for in this case all that is needful is to make a gold mould, by burnishing down the gold upon a medal or other object to be copied. Turn it upside down, and then enamel it over with a coating of enamel, laid on in the usual way. Then some large bits of enamel as big as beans should be piled on and allowed to melt till you have filled up the whole of the gold mould. It must be well annealed in hot sand or ashes. The gold cannot be picked off, but must be dissolved away by hot aqua regia, one part of nitric acid to four parts of hydrochloric, and you will have a very fair copy of the original medal in enamel, which will look like an antique gem. The dissolved gold can of course be used to colour enamel with. With care, the imitation gems can be made particoloured. By using flux with 10 per cent. of arsenic in it opal intaglios can be imitated.

But a better method of making artificial gems is to squeeze glass into a properly prepared mould of some material which will not stick to the glass. This condition excludes the use of clays of all sorts, or of any material containing alkalis or metallic salts. In 1712 the chemist Holmberg proposed a method of imitating gems with tripoli moulds which is said to have been practised with success, but which only seems to succeed with small pieces. After some experiments I have succeeded very well by the following method, founded in part on that of Homberg. Take fine tripoli of Venice. (This is composed of silica, with about 6 per cent. of clay, and coloured with a little iron.) Mix it with one-fifth of its bulk of the finest plaster of Paris, and having made them into a paste with water, cover the mould (which has been previously greased with suet) with a layer about one-eighth of an inch thick. Then fill in with common plaster of Paris. The commoner kind must be used for the filling, because the finer sorts of plaster, when unmixed with tripoli, will not stand furnace heat. You thus have a strong plaster cast, faced with fine plaster and tripoli, but with the body composed of common plaster. When it has well dried, put upon it a piece of glass, and put all into the muffle furnace. As soon as the glass begins to melt, the cast should be taken out of the furnace, and the glass pressed into it with a painter's putty knife. It should then be put back, and when it has become hot it may be pressed again, and if needful, more glass adde[d]. After four or five pressings it ought to b[e] finished, and may then be put into a mass of h[ot] ashes to cool, for three or four hours. Th[e] plaster and tripoli will come off on soaking [in] water. The glass should then be clean[ed] (carefully) with hydrofluoric acid. It is be[st] to use a dense flint glass, because this loo[ks] more brilliant, and is less likely to crac[k] with imperfect annealing. Where hardness [is] wanted, a soft soda or potash glass must b[e] used, but it must be most carefully anneale[d]. The edges can be shaped on an emery whee[l] or on a brass disc fed with wet emery powde[r] and finished up with emery powder upo[n] copper laps such as lapidaries use.

It may finally be polished with a soft circul[ar] brush, rotating in a lathe, and fed with putt[y] powder and water. The cutting and polishin[g] can easily be done by any lapidary. Varie[gated] pieces of glass cleverly arranged can b[e] got to imitate agate. Ordinary soft enam[el] is very suitable, and can be tinted by mixin[g] the enamels used for Limoges work with abou[t] six to twenty times the quantity of white glas[s]. A trace of violet manganese glass gives a viol[et] like amethysts, a little copper with a trace o[f] iron imitates an aquamarine.

In this way medallions may be modelled i[n] wax on pieces of flat glass, and then easil[y] reproduced in glass, but the greatest car[e] must be taken in long and thorough annealing.

By plique-à-jour we mean filigree wor[k] executed in gold or silver, and filled up wit[h] transparent enamels. It existed in the time o[f] Benvenuto Cellini.

It is done by first preparing the filigree. I[f] silver is employed, it must be pure, and sol[]dered with low-standard gold solder. Th[e] holes must not be more than about ¼-inc[h] diameter. The enamel is laid on with pur[e] water, the filigree being vertical. It is drie[d] and rapidly but gently introduced into a *ver[y] hot* oven. The enamel used must be soft, an[d] the initial heat very great, or else the ename[l] will not spread like a soap bubble over th[e] space.

Champlevé is difficult and requires considerable hand skill. Electro-gilding is essentia[l] for the artist in champlevé. The art of gildin[g] is very difficult, but may be learned fro[m] several excellent text-books.

The enameller, however, does not want t[o] learn the difficult process of gilding wit[h] alloyed gold, and, fortunately, to gild wit[h] pure gold is exceedingly easy.

Such gilding as this is very soft, and no[t]

able for the hard wear of personal jewellery. however, all that is wanted is to gild iature frames, enamels, clocks, and other ›cts which will not be submitted to rubbing, 1 gilding with absolutely pure gold is preble; for gold with the least alloy will iish, whereas articles gilded with pure gold never lose their colour.

'rocure a piece of absolutely pure sheet d weighing about 2 oz., and hence worth ›ut £9.

'ake a bain-marie, or one of those china s called "gourmet" cooking pots, of gallon capacity. Nearly fill it with distilled ter, to which add 1 lb. of cyanide of potasm. You must not use the common cyanide, a pure kind specially prepared for gilders. t the gourmet pot into a large saucepan or tle of water, and keep it at about 140° Fahr. h a Bunsen gas burner. If you have nstant current electric light in the house, ss the current through a 2- or a 5-candle np, and then put the ends of the wires one to each piece of gold; one of them will at ce begin to give off hydrogen gas. This is e negative pole. Put it inside a perfectly an porous cell to keep the gold from positing on it. Fill the cell with cyanide lution, and put it into the gold bath. The ld will then be dissolved from the positive le, and since the porous pot prevents it tting on to the negative pole, it will diffuse o the solution. As soon as the solution has ken up $\frac{1}{2}$ oz. of gold, the contents of the rous pot can be added to the bath and the rous pot removed, the piece of gold on the gative pole added to that on the positive le called the "anode," and the bath is ady.

The article to be gilded must be completely eaned, then well scoured with powdered imice stone, then boiled in hot cyanide of tassium for a few minutes, and then scoured ain with powdered pumice stone and water, ially well rinsed with clean water, and then it on the negative pole into the solution at a mperature of 140° Fahr., and gently moved oout. In about three minutes a reddishown coating of gold will have formed on it. his may then be washed, burnished with a ratch brush of fine brass wire, either on a the or worked by hand, and moistened with a tle beer, or vinegar and water. It will take a lendid burnish. It should then be washed, id dried in sawdust, heated in a vessel with water-jacket. If you have not got electricity the house, then a 2-cell Daniell's battery must be employed, but after each use it must be taken to pieces and washed, and the parts put away, or else the porous pots will be destroyed and the zincs also. The anode must be at least as large as the piece to be gilded, or else the gold will not deposit uniformly.

The advantage of the above method is that it does not seem to matter much how strong the current is, or how hot the solution is, or how strong the bath is. It succeeds almost any way, whereas the usual method of gilding is very delicate. The practised gilder who uses alloyed anodes can give any shade of colour he likes to the work. The above method can give the colour of pure gold only, but I think that colour is far more beautiful than any alloy. The old method of gilding was by means of mercury-amalgam. This method is very beautiful, but most dangerous, and those who practise it are liable not only to salivation, but even to necrosis of the jaw. (The same effect is produced by phosphorous, and known as "phossy jaw.") It is still a little practised.

We little think, when we see the beautiful old gilded work, what terrible illness it caused to the workmen, and just as little are we apt to reflect, when we see houses painted with white paint, or lead-glazed crockery, on the mortality they involve. But the days are rapidly approaching when these trade illnesses will be swept away for ever by the adoption of safer processes. It is now only a question of the time necessary to discover and apply them.

Very handsome frames may be made for enamels out of hammered iron plate.

German silver, also, gives a fine effect. Both these are, however, liable to tarnish, and cannot be heated in a muffle.

There is, also, a compound of nickel called kronand-metal, which works fairly well.

But for beauty of colour nothing comes up, I think, to pure nickel, which can, like iron, be obtained in sheets. It is capable of being soldered with hard solder, and a frame of nickel covered with ornamentation of burnished gold is very beautiful. The fire only gives it a sort of dull patina, which is very fine, and by the use of acids can be made almost any colour you like. If on the nickel you paint figures with gold powder mixed with gum water and a little borax, and fire them well in the furnace, and put on more gold and fire again once or twice, and then burnish the gold with a hematite burnisher, a very beautiful effect is obtained, like the Indian gold-inlaid work. The gold adheres well, and is difficult to get off except with a scraper. Nickel is

capable of producing all the effects of silver, and in addition does not tarnish. But it will not take enamel, for it gives rise to bubbles and the work comes off.

For work on this metal as described, it is always necessary to have a counter enamel, otherwise the coating may split off. But when the metal is thick, say 1-20th of an inch or over, no counter enamel is needed. In that case the enamel will hold. But unless there are cloisons, or deep incisions, or the work is well roughed or carved, there is always a danger of the enamel splitting off. The enamel is very apt to fly off small solid figures. For such work the best to use is a soft enamel, in spite of the fact that it is not well adapted for hard abrasive wear.

But the most durable work should be done on thin, fine gold well counter-enamelled, and set if need be in a solid setting.

The diamond is almost the only stone that will stand the fire, so that a setting of diamonds may be enamelled right among the diamonds, and all put together into the enamelling furnace. I have, however, met few persons courageous enough to try this apparently risky operation, and diamonds are usually inserted, like other precious stones, after the enamelling is finished.

Silver and copper and brass are improved in appearance by the formation upon them of a film or patina.

The Japanese are the greatest artists at this work, though their productions are often more fantastic and curious than beautiful.

The blackening of silver, or "oxidation," as it is usually termed, is done in many ways. One of the most common is to produce upon it a thin film of dark sulphide. This is effected by making a solution of a gramme of sulphide of potassium in 100 cubic centimetres of water (or $1\frac{1}{2}$ drachms to a pint). It is applied with a brush on the heated metal, and may be then scratch-brushed or burnished.

A scratch-brush is, as before described, a brush with fine brass wire bristles, used with vinegar or weak beer.

A paste (made up with water) of rouge and blacklead may be laid on copper and heated till the whole becomes black, then cool and brush with beeswax and a little of the paste dried.

It is also worth knowing that a sharp impression of a seal, very suitable for electrotyping, can be got by putting a sealing-was impression on an anvil, covering it with one or two pieces of soft sheet-lead, and t[...] hitting it a severe blow with a very he[...] hammer. Pressure would cause the wa[...] pulverize, but a quick, heavy blow drives [...] wax into the lead, producing a sharp imp[...]sion.

Miscellaneous.

SISAL GRASS IN MEXICO.

Henequen, or sisal grass, has been in use among [...] inhabitants of Yucatan from the earliest times. [...] United States Consul at Progreso says that he [...] found it imbedded in the form of cord in the stu[...] figures that ornamented the façades of the mysteri[...] ruined cities of Yucatan. There are two wild varie[...] of henequen called by the natives "cahum" [...] "chelem." The fibre of these wild plants is used [...] some extent by the natives in the making of cord[...] for domestic use, and some claim that hammo[...] made from the fibre of the cahum are the best. It [...] however, the cultivated plant that furnishes comme[...] with the fibre known as sisal grass, Sisal being [...] old port from which the fibre was first exported. L[...] the wild plant, the cultivated one is divided i[...] two varieties—the "zacci," or white hemp, and [...] "yaxci," or green hemp. The zacci is conside[...] the finest and best, but the yaxci is a good fibre. [...] has been generally supposed that sisal grass, as [...] article of commerce, has been known only within [...] last fifty years, but this is a mistake. Between [...] years 1750-1780 quite a furore was created in co[...]mercial countries of the Old World by the discov[...] that the fibre of a plant found in Yucatan w[...] good for ship's cordage. Spain sent over a Ro[...] Commission to report upon the discovery, and [...] a few years many of Spain's commercial and w[...] vessels were using cordage made from henequ[...] For some reason, probably because of the primiti[...] method of preparing it, the use of silk fibre gradua[...] declined, until at the commencement of this centu[...] the former trade had been forgotten. In 184[...] Yucatan, until then a cattle-producing, cotton-gro[...]ing, and logwood-exporting country, was in t[...] throes of an Indian war. The Maya Indians h[...] risen in rebellion, and had succeeded in driving t[...] white race out of the most fertile portions of t[...] peninsula, forcing them to rely for means of subsis[...]ence upon the products of a sterile rocky belt; to[...] poor to sustain cattle in any numbers. Henequ[...] was the only useful plant that would grow on such [...] soil. The first plantation was established in 184[...] and the 50 acres planted were cleared by the use [...] the tonka, the primitive cleaner used by the nati[...] Maya. There was a good demand for the new fib[...] in ship rigging, and it gradually came into gener[...] use, until sisal grass was a well-known article [...]

merce. The tonka was a piece of hard wood, ›ed something like a handsaw, having the end ›ed in. The leaf of the henequen was drawn ›ugh the sharp curve, and the fibre was stripped he thick, pulpy covering. The leaf was subjected this operation two or three times, until the fibre left clean and free. This tedious process was long tolerated. A machine was found to increase output, but the demand again outgrew the ply. The machine known as the "Raspador," he "Soles," from its inventor, came into use, and held its own almost up to the present day. It sists of a large-toothed wheel, that scrapes the p and leaves the fibre. Its simplicity made it uliarly fitted for use by the native servants. ntations came to be known as plantations of one, , or a dozen wheels. The constantly increasing ie necessitated still more rapid means of fibre ning. Many new machines were produced, each which was said by its inventor to be far better n any of the others. The exportation of sisal ss during the ten years ended December 31, 1898, ounted to 583,000,000 tons. It has been said that best fibre-producing plant grows on the poorest most rocky soil, but this does not accord with eriments recently made. One method of planting cultivating is as follows:—The field is first care- y prepared and burnt. The burning produces a ain amount of ashes, and many planters set out l corn at the same time they plant the henequen. : one does not interfere with the other in the st, and the corn crop helps to pay the cost of the equen. The henequen plant is propagated not by ls, but by scions, or suckers. The plant produces ls, and in a natural state propagates itself by h seeds and scions, but the planter uses only kers from 18 to 20 inches high. By this method can produce a field of henequen ready to cut hin five years, whereas by seed planting he would e to wait from eight to nine years. Once planted properly tended—that is, cleared of weeds twice ar, and not under or over-cut—a field will last 20 rs, and instances are not wanting of fields that e lasted longer. A leaf is ready to cut when it nds at right angles to the trunk or the plant. A lthy vigorous plant in the maturity of its growth uld yield from 18 to 24 leaves. One thousand es should produce from 50 lbs. to 60 lbs. of good, n fibre. This amount is a fair average. When plants in an old field send up a flower-stalk, it is ure's signal that the crop is finished. The old its must then be clipped of all useful leaves and down, to allow the young scions (which should e been already planted between the old plants) tilation for growth. Bad cleaning, allowing rot be produced by the acids nascent in the plant pulp, dampness, produce red and mould-stained fibre, less than one-half the value of the good, clean, te fibre. This is rarely exported, but is sold at ie for domestic use. There are in Yucatan nearly o henequen-producing plantations of various sizes. The largest plantation, or, rather, the plantation producing the largest output, is on the line of the broad gauge railway between Merida and Progress. It is called Ticilchè, and produces about 1,000 bales, or 375,000 lbs. of cleaned fibre per month.

ARTIFICIAL COAL IN GERMANY.

The United States Vice-Consul at Mannheim states that he has recently assisted at a trial to demonstrate the combustible properties of an artificial coal invented in Germany, and has observed its ready inflammability and its apparently considerable heating qualities. The inventor claims that all sorts of earth may be used for his substitute, with the exception of sand and gravel; but it is thought that only those whose component parts are vegetable or ligneous, as moor peats and turf lands, would be available. The inventor also enumerated, among suitable substances, various kinds of clay, but in the opinion of the Vice-Consul these would probably have to be used as an admixture with the vegetable soil for graduating the heating qualities of the coal. Certain ingredients are mixed with the earth and worked into a homogeneous mass for the purpose of making it inflammable. These ingredients are the inventor's secret, but since his preparation is intended to have the properties of pit coal, their nature can be easily guessed. They are to take the place and produce the effect of the bitumen of the mineral article, and must be substances of quick ignition and combustibility, such as pitch, resin, naphtha, or similar products. One hundred kilogrammes (220 lbs.) of such articles may be bought at Mannheim for about 8s. 4d., but only 6 to 8 per cent. are required for 50 kilogrammes (110 lbs.) of the artificial coal. Including labour and general expenses, the cost for the quantity would be, say, $3\frac{1}{2}$d. A tract of land bought lately by the inventor furnishes 50 kilogrammes (110 lbs.) of earth especially suited for the purpose, for about one farthing; so that 50 kilogrammes (110 lbs.) of the artificial coal will cost not more than $3\frac{3}{4}$d. to produce. This calculation is taken from the notes of the inventor. The cheapness will be best illustrated by comparing the prices of the various grades of pit coal, which have run in the last year from $8\frac{1}{2}$d. to 1s. $1\frac{1}{2}$d. per 110 lbs., at Mannheim. The artificial coal, of a greyish black, is pressed in blocks (briquettes) of three sizes, viz.:—No. 1—$7\frac{1}{4}$ inches long, $2\frac{1}{2}$ inches broad, $1\frac{1}{2}$ inches thick; No. 2—$6\frac{1}{2}$ long, 4 broad, $1\frac{1}{2}$ thick; No. 3—$3\frac{3}{4}$ long, 3 broad, $1\frac{1}{2}$ thick. The blocks are hard and brittle, and when thrown into the furnace whole or in pieces, they ignite readily, and burn briskly. The suggestion that for technical establishments blocks of larger size would be desirable was answered with the statement that forms for making 10 lb. pieces were already in preparation. The result of an examination of this coal by the technical assayers at Karlsruhe showed that it contained—water 14·79 per cent., ashes 17·73, and combustible substance 67·48 per cent.

THE FRENCH WINE CROP.

The reports received from the wine-producing districts of France, Algiers, and Tunis, record a yield of about 1,056,000,000 gallons in 1899. Early frosts reduced the production in some districts, as in the Drôme, where it was 3,300,000 gallons in 1898 and 2,948,000 gallons in 1899. The department of the Rhône produced 17,600,000 gallons, two-thirds of which is known as Beaujolais. In the Gironde, the yield was 64,372,000 gallons against 51,810,000 in 1898. In the Herault, where a very good quality of ordinary wine is grown, the yield in 1899 was 212,410,000 gallons against 148,390,000 gallons in 1898. The department of the Eastern Pyrenees yielded 47,916,000 gallons against 22,000,000 gallons in 1898. The agriculturists in France, are, according to the United States Consul at Lyons, devoting more of their land to wine growing at present than at any time during the past forty years. Stock raising and grape growing are considered the two most profitable pursuits for the farmer. While the production and consumption in France are steadily increasing, the exports are diminishing. The quantity exported in 1887 was 54,582,000 gallons. In 1897, ten years later, they had fallen to 39,028,000 gallons. Wine growers were compensated for this shrinkage by an increase in prices, the value of the exports of 1887 being £9,348,000; for 1897 it was £9,540,000. A notable change has also occurred in the direction taken by exports. In 1887 they were almost equally divided between European nations and the countries over the seas. In 1897 three-fourths of the exports were absorbed in Europe, where the number of the consumers increased, and the home production remained almost stationary. The principal decline was in Africa and the countries of South America, especially in the latter, where the wine exports were valued at £2,080,000 in 1887 and only £680,000 in 1898. At a meeting of the National Agricultural Society last year it was set forth as a fundamental principle, never to be lost sight of by French wine growers, that their success must in the future depend entirely upon grafting. This principle is also applicable to the wine growers of Spain, Italy, and perhaps other countries.

CANADIAN SEA GRASS FOR UPHOLSTERING.

Sea grass is a long thin grass that grows on the protected flats of the Lower St. Lawrence River, along the south shore of the counties of Gaspé and Bonaventure, in the province of Quebec, and on the east shore of the province of New Brunswick. The grass grows from 2 to 4 feet long at Isle Verte and Rimouski. At these places the bottom is hard, and teams can drive anywhere on the flats. The flats at Gaspé, Bonaventure, and New Brunswick are generally soft, and the grass grows from 5 to 12 feet long. Geese and ducks as they migrate stop to feed on grass. Geese commence to arrive in March leave about May 10th for the breeding grou farther north, returning in September. The gras known as *herbe à bernige* (brant grass) and *herl outarde* (wild goose grass). These flats are v extensive in places. At Isle Verte over 1,000 t of grass are cut and 400 tons can be cut at Rimou Islands protect the flats from heavy seas. The g is mown with scythes. It takes a very large are dry much of it, and it shrinks rapidly in the s 100 lbs. of the green grass making only about 12 of the dry. If dried quickly with the salt in it i very brittle. To season it well requires from three four weeks. After it becomes dry showers are nee to take the salt out of it. The dew will accomp this object, but it takes much longer. M experience and care are necessary to cure it prop and to render it entirely free from salt. W properly dried the grass is strong, elastic, curly, giving it its value for upholstery. It is larg used by carriage manufacturers. The grass was f cut in Canada in 1891. At the present time po presses are used to bale it, and from 10 to 15 t are put in a waggon. The amount of the yield 1898 was as follows:—Isle Verte, St. Eloi a Cacouna, 1,120 tons; Rimouski, 163 tons; Se Islands, 55; Paspebiac district, 45, and N Brunswick, 90 tons; total, 1,473 tons. The Uni States Commercial Agent at Rimouski says t about 10 per cent. of this quantity was used Canada and the balance went to the United Stat He adds that when the sea grass becomes bet known it will be more popular. It is clean, healt elastic, durable, light and cheap.

General Notes.

Technical Instruction Congress, Par 1900. — An International Congress of Techni Instruction will be held in connection with t Universal Exhibition in the Palais des Congrès fr the 6th to the 11th of August. The President M. L. Bonquet, the General Secretary M. Mic Lagrave, and the Assistant-General Secretary Emile Paris. The Congress is divided into t sections:—1. Industrial Education; 2. Commerc Education.

Mines and Quarries. — The tables of fa accidents and deaths in and about the mines a quarries in the United Kingdom during the ye 1899 have been published by the Home Office advance of the General Report. The total num of separate fatal accidents in coal mines was 863, an advance of 35 over the amount in 1898. T total is made up as follows:—Explosions of firedar or coal dust, 23; falls of ground, 424; in shafts, 6

ellaneous underground, 235; on surface, 114. separate fatal accidents in metalliferous mines unted to 47, or an increase of 16 over 1898. The rate fatal accidents in and about the quarries of at Britain and Ireland amounted to 117, or a ease of 14 on the total of 1898.

OURISTS IN SWITZERLAND.—It is estimated since the 1st January, 1899, up to the 31st ober last, no less than 2,500,000 tourists have ted Switzerland, and that they have each left in country an average of 80 francs (£3 4s.), or a l of £8,000,000. Inasmuch as the population of itzerland is only 2,933,300, it is difficult to appre- e the significance of these figures. The *per capita* lth of the country has hitherto been estimated at 18s. 4d., but the influx of money above referred to denly brings it up to £6 2s. 4d., or from one of poorest countries (*per capita*) to one of the richest. nsul Ridgely, of Geneva, says that this would least appear to be the result on paper, but as a tter of fact, the sudden increase of the country's lth is not so great as the figures would indicate, the reason that Switzerland buys nearly every- ng she sells to tourists, including the supplies for hotels and boarding-houses; and therefore, while reat deal of money comes into the country, a large portion of it has to be paid out. However, the rease in the country's wealth from the tourist move- nt during 1899 is notable, hotel-keepers being the gest gainers.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

JANUARY 17.—"Ventilation without Draughts." ARTHUR RIGG. SIR JAMES CRICHTON OWNE, M.D., LL.D., F.R.S., will preside.

JANUARY 24. — "Local Government and its re- ion to Parish Water Supply and Sewerage." W. O. E. MEADE-KING, M.Inst.C.E. SIR NJAMIN BAKER, K.C.M.G., will preside.

JANUARY 31.—"The Undeveloped Resources of Bolivian Andes." By SIR W. MARTIN CON- AY, M.A.

FEBRUARY 7.—"Housing of the Poor." By MUND WILSON.

FEBRUARY 14. — "The Diffraction Process of lour Photography." By PROFESSOR R. W. WOOD.

FEBRUARY 21. — "Artistic Copyright." By DWIN BALE.

MARCH 14.—"Continuation School Work in ural Districts." By H. MACAN, M.A., F.C.S.

ates to be hereafter announced:—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN THORNYCROFT, F.R.S., M.Inst.C.E.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Electrical Induction Motor on Mountain Railways." By PROFESSOR CHARLES A. CARUS-WILSON, M.A.

"The Orloff Process of Colour Printing." By W. H. WARD.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

JANUARY 18.—"Our Work in India in the 19th Century." By SIR WILLIAM LEE-WARNER, K.C.S.I., M.A. The Right Hon. the LORD JAMES OF HEREFORD will preside.

FEBRUARY 8.—"New Projects of Railway Communication with India." By JAMES MACKENZIE MACLEAN, M.P. LORD EDMOND FITZMAURICE, M.P., will preside.

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

[The meetings of January 18, February 8, and May 17 will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

Tuesday or Thursday afternoons at 4.30 o'clock:—

FEBRUARY 1 (Thursday).—"The Century in our Colonies." By The Right Hon. SIR CHARLES WENTWORTH DILKE, Bart., M.P.

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

MARCH 20 (Tuesday).—"Imperial Telegraphic Communication." By SIR EDWARD A. SASSOON, Bart., M.P.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

JANUARY 30.—"Niello Work." By CYRIL DAVENPORT. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

FEBRUARY 13.—"The Best Means of Arresting the Decay of Indian Art." By JOHN SPARKES.

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

APRIL 3. — "Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

MAY 8.—

MAY 29.—

CANTOR LECTURES.

Monday evenings at 8 o'clock :—

BENNETT H. BROUGH, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

LECTURE I.—JANUARY 22.

Deposits in which ores of the useful metals are met with—Beds, veins and masses—Classification of ore deposits—Methods of mining formerly employed—Recent improvements.

LECTURE II.—JANUARY 29.

Sources of the world's supply of gold and silver—Principal mines now worked—Future resources.

LECTURE III.—FEBRUARY 5.

Sources of the world's supply of iron ore—Principal mines now worked—Future resources.

LECTURE IV.—FEBRUARY 12

Sources of the world's supply of copper ore—Principal mines now worked—Deposits of the ores of lead and other metals.

⁂ Lectures illustrated by lantern photographs.

E. SANGER SHEPHERD, "Photography of Colour." Four Lectures.
March 5, 12, 19, 26.

PROFESSOR JAMES A. FLEMING, D.Sc., F.R.S., "Electric Oscillations and Electric Waves." Three Lectures.
May 7, 14, 21.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 15...Imperial Institute, South Kensington, 8½ p.m. Rev. R. Sellors, "New South Wales, its Resources and Possibilities."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. John Nisbet, "Forest Management, with Suggestions for the Economic Treatment of Woodlands in the British Isles."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. W. Webster, "Further Discoveries with the X Rays."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. F. G. Pinches, "Notes on Oriental Congress, Rome, 1899."

London Institution, Finsbury-circus, E.C., 5 p.m Dr. J. A. Fleming, "Æther and Atoms."

UESDAY, JAN. 16...Royal Institution, Albemarle-street, W., 3 p.m. Prof. L. Ray Lankester, "The Structure and Classification of Fishes." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on following papers: (*a*) Mr. Reginald A. Tatton, "The Purification of Water after its use in Manufactories;" (*b*) Mr. W. O. E. Meade-King, "Experiments on the Purification of Waste Water from Factories." 2. Mr. J. A. Sauer, "Swing-bridges over the River Weaver at Northwich."

Statistical, (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 5 p.m. Mr. Cornelius Rozenraad, "The International Money Market."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. (Photo-Mechanical Meeting.) Mr. W. Gamble, "Screen Gears for Half Tone."

Colonial, Whitehall-rooms, Whitehall-place, S. 8 p.m. Hon. Sir Philip O. Fysh, "Tasma Primitive, Present, and Future."

WEDNESDAY, JAN. 17...SOCIETY OF ARTS, John-str Adelphi, W.C., 8 p.m. Mr. Arthur Rigg, "V tilation without Draughts."

Meteorological, 25, Great George-street, S.W. p.m. Annual General Meeting. Address by President (Mr. F. Campbell Bayard), "A Discussion of the Greenwich Meteorolog Observations, 1848-1898."

Microscopical, 20, Hanover-square, W., 8 Presidential Address.

Entomological, 11, Chandos-street, W., 8 Annual Meeting.

Archæological Association, 32, Sackville-street, 8 p.m.

Mining and Metallurgy, Geological Muse Jermyn-street, S.W., 8 p.m. 1. Messrs. D. Morison and D. A. Bremner, "A Developmen Gravitation Stamp Mills." 2. Mr. D. A. Lo "Notes on Gold and Platinum Mining in the Mountains."

THURSDAY, JAN. 18...SOCIETY OF ARTS (East Confere Hall, Imperial Institute), 4½ p.m. (Indian Secti Sir William Lee-Warner, "Our Work in Indi the 19th century."

Royal, Burlington-house, W., 4½ p.m

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. M. Kyle, "The Existence of Nasal Secretory and of a Nasopharyngeal Communication in Teleostei." 2. Mr. George Massee, "The Or of the Basideomycetes."

Chemical, Burlington-house, W., 8 p.m. 1. Mes Julius Stieglitz and E. E. Slosson, "Nitro Halogen Compounds." 2. Messrs. W. J. and F. W. Dootson, "Chlorine Derivatives of ridine." (Part V.) "Synthesis of $\alpha\alpha'$-Dichlor ridine and Constitution of Citrazinic Acid." 3. A. Lapworth and Mr. E. M. Chapman, "Actio Fuming Nitric Acid on α-Dibromocamphor." Dr. E. C. Szarvasy, "Electrolysis of Nitro Hydrides and of Hydroxylamine."

London Institution, Finsbury-circus, E.C., 6 Mr. W. St. Chad Boscawen, "Beginnings Trade and Commerce."

Royal Institution, Albemarle-street, W., 3 Dr. W. H. R. Rivers, "The Senses of Primi Man." (Lecture I.)

Historical, St. Martin's Town-hall, Charing-cr road, 8½ p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing cross-road, W.C. 8½ Mr. C. H. Bothomley, "Developers, Old New."

Junior Engineers, Westminster Palace-h S.W., 8 p.m. Prof. W. Dalby, "The Balan of Engines."

FRIDAY, JAN. 19...Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting. 9 p.m. Lord Rayle "Flight."

North-East Coast Institute of Engineers and Sl builders, Newcastle-on-Tyne, 7½ p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 Mr. J. Castle-Evans, "Mechanical Physics."

Quekett Microscopical Club, 20, Hanover-squ W., 8 p.m.

SATURDAY, JAN. 20... Society of Women Journalists (at HOUSE OF THE SOCIETY OF ARTS), 8 p.m. Oscar Beringer, "Women Dramatists of To-d

Royal Institution, Albemarle-street, W., 3 Sir Hubert Parry, "Neglected Bye-ways Music." (Lecture I.)

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FRIDAY, JANUARY 19, 1900.

ommunications for the Society should be addressed to e Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

he absence of Major Cardew from England prevent his fulfilling his engagement to ver a course of lectures on the "Supply of ctrical Energy" before the Society; but the ncil are glad to be able to announce that fessor James A. Fleming, D.Sc., F.R.S., undertaken to deliver a course on "Electric illations and Electric Waves," to be given May 7th, 14th, and 21st.

COVERS FOR JOURNAL.

or the convenience of Members wishing to d their volumes of the *Journal*, cloth ers will be supplied post free for 1s. 6d. h, on application to the Secretary.

LIST OF MEMBERS.

he new edition of the List of Members of Society is now ready, and can be obtained Members on application to the Secretary.

Proceedings of the Society.

CANTOR LECTURES.

RT ENAMELLING UPON METALS.*

Henry Hardinge Cunynghame, C.B.

cture IV.—Delivered December 11, 1899.

The Manufacture of Enamel.

namel consists of glass. Glass is comed of silicates of various materials. In ure it therefore somewhat resembles a salt, that is to say, the union of an acid with a base; but it contains no water of crystallisation, nor is it in a crystalline form. It is amorphous, that is to say, like a mass of solid varnish or glue; it possesses no definite structure. There are two acids which enter into the composition of glass, namely, silica (the oxide of silicon) and boracic acid (the oxide of boron), but the latter, as we shall presently see, is not a desirable ingredient. The bases which are mixed with the above-mentioned acids to form glass are, in the first place, soda and potash, being the oxides of the metals sodium and potassium. In addition to these, oxide of lead is an essential component of glasses used for enamelling, on account of the peculiar elasticity and other qualities which it produces, but we may also have as a base alumina, chalk, or magnesia. These last, though much used as bases in the composition of window glass or of the glasses used in glazing china and pottery, are of no particular value in the composition of enamels—indeed, they are apt to alter the shade of some of the colouring matters employed, and to produce complications in the character of enamel, which, for facility of manufacture, it is desirable to keep as uniform and simple as possible. Instead of lead, bismuth might be employed, but it possesses no advantages over lead, and its great cost renders its use undesirable. For certain kinds of optical glass, baryta (the oxide of barium) is used; it is found to give whiteness and uniformity, but produces no quality in the glass which improves it for use as an enamel.

Silica (SiO_2) occurs in nature in the form of sand, flint, agate, or quartz. As found in nature, it is crystalline. When pure, it is of a dazzling white. Its coloration usually proceeds from a small admixture of iron. When pure, it cannot be melted except with the oxy-hydrogen blowpipe, upon which it loses its crystalline structure and becomes amorphous. It may be drawn out into threads, and, if it could be subjected to sufficient heat, might be worked like glass. If this could be done, we should be in possession of a magnificent material, a perfect non-conductor of electricity, absolutely unchangeable by atmospheric influences, indissoluble by almost all chemical substances, of a hardness approaching that of the diamond, and perfectly translucent; but the power of working at the tremendous temperatures necessary to make pure quartz ware belongs not to the present, but to the future.

* These lectures are copyright.

But when silica is heated with any metallic oxide such as soda, potash, alumina (clay), magnesia, baryta, oxide of lead, oxide of iron, it fuses into a glass or slag. This fact forms the foundation of all glass, earthenware, pottery, tile, and brick-making. In conjunction with potash or soda, silica is capable of forming two distinct orders of compounds—one, an insoluble silicate known as ordinary glass; the other, of the kind known as the soluble silicates of soda, or potash, commonly called water-glass. These curious soluble silicates are produced by strongly heating powdered silica with four or five times its weight of soda or potash, and then boiling the result with water. They may be obtained from any druggist in a form resembling thick mucilage, which may be thinned down with any amount of water, and in this more liquid form are employed mixed with fireclay for mending furnaces, or with lime and other materials for producing artificial stone and indelible whitewash. Water-glass has this curious property, that, if in the liquid form it is mixed with a powerful acid, such as hydrochloric acid, it is decomposed, the hydrochloric acid entering into composition with the soda or potash, forming chloride of sodium (common salt) or chloride of potassium. The silica thus isolated remains either dissolved in the water or else in the form of a cloudy, gelatinous mass, which, when dried, becomes a light, fine powder of dazzling whiteness. In this state it is insoluble, so that dissolved silica, when dry, becomes insoluble, and can only be rendered soluble again by the artifice of making it into water-glass with alkali, and then removing the alkali with hydrochloric acid. But water-glass would be quite unfit for the manufacture of enamels, or for making windows or bottles. For these, an insoluble silicate is needed, and this may be obtained by simply reducing the quantity of soda or potash. If we melt together three parts of silica to one of soda or potash, the mixture requires far greater heat to fuse it, but instead, as in the case of water-glass, of becoming an opaque white mass soluble in water, it now takes the white transparent form which is so well known. Another very curious property of silica is, that its acid properties are only fully developed by heat. At low temperatures it is a weak acid, so that silicate of soda is decomposed by hydrochloric acid. But at a red heat it becomes the most powerful acid known, dissolving everything, and displacing all other acids. The glass-maker usually employs sea sand for his quartz, but owing to the iron with whi almost all sand is contaminated, the resulti glass becomes of a dirty yellow or bottle gree for the finer sorts of glass, therefore, a pu white sand from Fontainebleau Forest or Pe well Bay is much in request. Silica is al sometimes got by calcining common flints a then plunging them into cold water so as crack them up. They are then ground w water in granite mills; but this is an expensi process, only employed for certain glazes us in china-making. The soda and potash obtai able by the glass-maker have not, till rece years, been free from iron, and hence c glasses were always apt to be slightly ting with colour. Better alkalis are now in gene use, but in old days it used to be customary neutralise the tint produced by the iron by t addition of a small quantity of mangane Silica is capable of uniting not only with alka but also with lead, lime, magnesia, and cl (hydrous silicate of alumina). In conjuncti with these it forms glasses of different sor but if the amounts of lime, magnesia, and cl are large, the mixture does not become trar parent, and, in fact, is only partly vitrified. In th condition it is "porcelain." Crockery consis of clays, lime and magnesia, containing or very small proportions of silica; and earthe ware consists wholly of these earths or clay with no silica to speak of other than that chemical combination in clay. Thus, the glass, porcelain, crockery, earthenware, bric are all a kindred family, consisting of silica of soda or potash, or lime, alumina, and ma nesia, and varying from the finest crystal do to the most ignoble slag. There is no sha dividing line. Glass glides into semi-trar parent porcelain, this again into china, chi into crockery, crockery into earthenwa earthenware into terra-cotta, terra-cotta ir brick. And all the family may be glazed ov with glasses of various descriptions. In fa any substance, clay or metal, may be glaz over with glass like a coat of varnish if only will stand the heat necessary to melt the glas but the "body" must be adapted to the gla or else the glaze will crack, or, as it is tech cally termed, "craze." The glazes on chir bricks, tiles, and enamelled pots are only many varnishes made of various preparatio of silica.

The Alkalis.—The word alkali, derived fr the Arabic, is used for the oxides of sodi and potassium, which are obtained from wo and various plants. If wood ashes are boil in water, the water extracts from the ash

atter of a soapy taste, most valuable as a eansing agent, and which, when mixed with ay form of grease, forms what is known as oft soap; hence greasy plates boiled with wood shes would become perfectly clean. In former ays washerwomen used to clean clothes ith the ashes from their wood fires, and his is still done in France, Soda used once o be confused with potash, for the distinction etween the two substances was unknown. Certain plants of the order known as frog-rass, and which are found in Egypt and ther parts of the world, are rich in soda. Soda, combined with grease, forms hard soap. Both soda and potash are used by the glass nd enamel-maker. Potash is best when it s desired to obtain whiteness and brilliancy, but when a glass is required which shall be asily fusible, and elastic, and shall possess he valuable property of remaining ductile for ome time after it is heated red-hot, or, in other words, of being malleable at a red-heat, soda is employed. Alkalis have the property of rendering glass more readily usible. This effect also is produced by lead. But where the enamel is required to be easily usible but yet hard, alkali is preferable to ead. On the other hand, however, glass rendered fusible by considerable quantities of alkali is more likely to crack if imperfectly annealed, and has a less brilliant surface. Soda is much cheaper than potash, a fact which becomes very apparent when we reflect that the salt of the sea is almost wholly composed of chloride of sodium. Our forefathers did not know how to extract the soda from chloride of sodium, and hence were unable to adopt what may appear the simple plan of making their glass out of sea salt, but modern science by means of electrical processes is able to do this with ease, and soda is now becoming cheaper than ever. It would be of no use trying to make glass by fusing together silica and sea salt (chloride of sodium), for the chlorine holds the soda too fast to allow the silica to get it at any practicable temperatures. For glass-making we must employ some form of soda salt, the acid of which is of a less tenacious character, and therefore the sulphate, the nitrate, or the carbonate should be used; and the same is true of potash. Considerations of economy cause the use of a good deal of sulphate of soda, but the sulphur from the sulphate is apt to discolour the glass. Nitrates of potash and soda are very excellent, but are expensive, as the nitric acid used in their manufacture is costly. For the finer sorts of enamel, a soda is specially made, quite free from iron, called enamel-maker's soda. Hence the best materials for the enamel-maker to employ are the carbonates of soda and potash. When these are heated with silica to a bright red, the acid character of the silica, which manifests itself so little at lower temperatures, is brought into play, and, being more powerful than carbonic acid, it drives this out of the carbonate of soda; therefore the effect of the heat upon the mixture is to make it froth up, and first, to drive out in the form of steam the very large quantity of water of crystallisation which carbonate of soda possesses, and next, as the glass forms, to expel the carbonic acid, which bubbles up through the melted glass as it does in soda water. The water of crystallisation in the ordinary carbonates of soda and potash is uncertain in amount, varying with different specimens, and amounting sometimes to half their weight; it is therefore usual, before employing them, to calcine them thoroughly and then to keep them in dry bottles so as to prevent them absorbing more water. In all the formulæ about to be given it will be assumed that perfectly dry calcined carbonates are employed, which can be purchased ready prepared from manufacturers of chemicals. There is, however, an important use to which the nitrates of potash and soda can be put and which renders them indispensable; it is due to their great oxygenating power. In the operations that will be presently described, there is a danger lest the carbon derived from the carbonate of soda may reduce the other ingredients to a metallic state. Oxide of lead is especially liable to this reduction, which causes the mass of enamel to become of a dirty black colour. Throughout the whole operation of melting enamels it is therefore necessary to keep the mass of melted matter well oxidized, and for this purpose no ingredient is so valuable as nitrate of potash. The large amount of oxygen that this substance contains, coupled with the ease with which it yields it up, is the reason why when mechanically mixed with carbon it forms gunpowder. If about 2 per cent. of it is mixed into the ingredients for making glass, reduction of the metals will be properly guarded against.

Lime (CaO.).—The addition of chalk (carbonate of lime) to silicate of soda constitutes with other ingredients the glass used for bottles and windows; the chalk increases the

fusibility and the brightness and hardness of the material, but is of no service for enamels. On the contrary, it is rather prejudicial, as it makes them less flexible and less ductile when hot. It is, however, frequently found in small quantities in purchased enamels; its presence is an indication that window or bottle glass has been used in their composition. It is no bad plan to make enamels out of broken window glass, for repeated re-melting greatly improves the quality; indeed, as will subsequently be shown, good enamel must be repeatedly fused and kept constantly in a state of fusion, and for this reason the enamel-maker should procure ready-made glass of good quality and known composition, and, having reduced it to a fine powder, should make his enamel by melting it up with other proper ingredients.

Lead (Pb.) enters into the composition of enamel in the form of oxide, and unites with the silica to make a silicate of lead. The glass, therefore, becomes an alloy of silicate of lead and silicate of soda or potash. It is sometimes recommended that the proportions of silica, oxide of lead, and alkali in glass should bear some definite ratio to the chemical equivalents of those materials, with a view of making the resulting glass rather into a chemical combination than a mere alloy; but it has been pointed out that mixtures or alloys of metal and other substances may be made without any regard to combining proportions, and indeed that the adoption of these proportions might rather have the effect of making the glass crystalline, that is to say, of its becoming devitrified, than of assuming that perfectly amorphous condition which is so valuable. The effect of the introduction of oxide of lead into glass is to make it softer, that is to say, more easy to scratch, more elastic, more malleable, and enormously to increase its refractive power; at the some time its melting-point is reduced to a degree considerably below the melting-point of copper. It is also much less likely to crack even when the annealing is imperfect. These qualities are those which make it possible to cover copper with a layer of melted glass without melting away the copper which serves as a foundation. Glass containing one-third of its weight of oxide of lead is known as flint glass; it is used for telescope glasses on account of its high refractive power, and for cut table glass on account of its brilliancy. On the continent it is termed crystal. It was known to the ancients. Its specific gravity is about 3, or 3·2. Larger quantities than this of lead can be introduced into glass. When the amount of oxide of lead is about one-half the weight of the glass, it is termed dense flint and has a specific gravity of about 3·6. Even larger quantities still of lead can be added, so as to raise the specific gravity up to 5, and enormously to increase the refractive power; but flint glass so dense as this is very difficult to make because the lead is apt to separate and cause devitrification. All flint glass has a faint yellowish tinge, and when the amount of oxide of lead reaches 60 per cent. the tinge is very perceptible. Very dense flint is used for the imitation of precious stones such as the diamond, and many secrets exist for making it of a white colour, but artificial diamonds are easily detected, for not only are they soft, but they are also opaque to the Röntgen rays, whereas the diamond is almost perfectly transparent to them. Lead is introduced into glass either in the form of the yellow oxide, commonly known as litharge, or else in the form of red-lead. There is, however, a danger that it may be reduced to a metallic state during the melting. A very slight quantity of free carbon present in the mixture would effect this, for a quantity of carbon can reduce to a metallic state more than thirty times its weight of lead. Therefore, in making flint glass, care must always be taken to introduce some oxidising agent, and for this purpose a portion of the alkali is usually supplied in the shape of nitrate of potash. English flint is usually made with potash instead of with soda, because flint soda glass has a more yellowish tinge than flint potash, but in France crystal is frequently made with soda. Enamel consists simply of flint glass more or less dense. The harder kind of enamel, used upon watches and jewellery that has to withstand wear, is made of ordinary flint glass, containing 30 or even 20 per cent. oxide of lead; but such enamel is not very fusible, and has to be employed with care, lest in the application of it the metal which serves as its foundation should melt. It is sometimes made more fusible by large additions of soda or potash, but this makes it more easily affected by moisture, as does also the introduction of borax, which is very strongly to be deprecated. For enamels in the Limoges style, which are to be looked at but not rubbed, or for enamelled ornaments which are not to withstand wear, nothing is better than a dense flint containing, say, 45 per cent. of oxide of lead; this is white, has a brilliant surface, and melts easily, so that there is little danger of

metal on which it is applied becoming own out of shape in the muffle furnace. nse flint has, however, a disadvantage in s, that being so rich in lead, a very little bon, such as a speck of dust upon the sur-e before it is put into the furnace, will cause formation of a speck of metallic lead, ich has to be cut out and filled up. With e there is no difficulty in preventing the sence of dust, and consequently such soft amel is very suitable, for it melts at a low nperature, and thus there is no danger of copper plate being distorted, and the large ount of lead gives greater brilliancy. It is ficult to procure fragments of real old amel for analysis on account of their great ue. I am inclined to think, however, that quantity of lead used in them was not more in 20 per cent., but in many cases they m to have been rendered fusible by the of borax, for I have noticed several old amels which, in damp weather, were vered with beads of moisture, due to the grometric qualities of this pernicious in-edient.

Borax (Na_2O2BO_3+10Aq) is a borate of la. Boron is an element having properties it render it analogous to silicon. The responding acid to silica is boracic acid $_3BO_3$).

From this it might be inferred that just as ca (*i.e.*, silicic acid) forms silicates with all ts of metallic oxides, so boracic acid would m borates. And this is the case. These ates are as a rule fusible, and exceedingly rd, that is to say, they will generally scratch ss. Boracic acid also unites easily with tallic oxides, and hence takes colour well, d also causes the glass to become very uid and flow easily. It is therefore often ed to make easily fusible enamels. But it s two defects. In the first place, enamels de with it are liable to crack, and are ficient in elasticity; and in the next place, ey are very susceptible to moisture. Faraday, search of a highly refractive glass, found it he could unite enormous quantities of d in borax glass, but the product speedily nished. Otherwise it would have made a endid optical glass for certain purposes.

More church windows have suffered from rain through the use of borax than from other cause, and there is no need to ploy it, as perfectly good enamel can be de without it. In fact, its only use is to nbine fusibility with a hard surface, and as re is no need for making Limoges enamel with a very hard surface, the necessary fusibility can be better obtained by means of lead.

Alumina, or clay, occasionally enters into the composition of glasses, but is of no use in the fabrication of enamels except in the formation of some greens, which, however, can be very well made without it.

The above-mentioned materials form a colourless glass called "fondant" in French, or "flux" in English.

Colouring Matters.—The colouring of enamels is effected by the addition of small quantities of various metallic oxides, which, being dissolved by the silica, to which they act as bases, form silicates.

The principal metals so used are: copper, antimony, gold, chromium, iron, nickel, cobalt, manganese, platinum, iridium, and uranium. It is easy to test these colours by making a small bead of borax in a loop of platinum wire and heating it in the blow-pipe flame. The higher oxides of the metals formed in the outer flame at its extreme end as a rule give the best results. Red is obtained from gold; yellow from uranium and antimony; blue from cobalt; violet from manganese; green from various mixtures of iron, chromium, copper, zinc, and cobalt. A great variety of greens is obtainable. Black is produced by a mixture of cobalt, manganese, and iron; brown from iron and manganese, and also from nickel. Opaque white is obtained by mixing the flux with oxide of tin, white arsenic, or phosphate of lime. A splendid black and most delicate shades of grey are produced from iridium, but it is a very expensive material. A soft, dove-coloured grey can be got from platinum. All the above ingredients can be mixed together to produce various shades of colour, but the brilliancy of the colouring is greatly reduced in mixtures, and besides, very unexpected results occur. One would think that cobalt blue, combined with uranium glass, the colour of barley sugar, would produce a green; on the contrary, it forms a fine indigo. Yellowish-green iron mixed with violet manganese produces red. Nothing but experiment can determine the colours resulting from mixtures, of which more will be said by-and-by. The shade of these colours depends generally upon the state of oxidation of the metallic oxide. Thus, manganese, if well oxidized, gives a purple colour; if less oxidized, it is reddish. Cobalt also becomes more red if well oxidized. Iron becomes more yellow if oxidized. Selenium when oxidized gives a full yellow, but if less oxidized, it gives a rose colour.

I now proceed to describe the method of practically making enamels. First we must make a flux. This may be either a hard flux, containing about 30 per cent. of oxide of lead, or a soft one, containing about 45 per cent. of oxide of lead.

I will first describe the furnace. For ordinary work it is advantageous to have a somewhat small furnace, capable of holding about 1½ lb. of melted enamel. It should consist of a cylinder of fireclay, open at top and bottom, and should be 7 inches high, 5½ inches internal diameter, and with walls 3¼ inches thick. The bottom should consist of a large slab of fireclay with a trench in it, so that any melted glass that falls down the sides of the crucible may flow into it and not stick the bottom on to the furnace. It will easily hold a Morgan's crucible, 4½ inches high and 3½ inches diameter across the mouth. The crucible should stand on a base 2 inches high, put on the bottom. By having the bottom separate from the body the furnace is kept from being clogged up, and is more easily repaired; for enamel-making is very apt to make a mess, and the enamel runs on the fireclay, and sticks to it so hard that it can only be got off with a chisel and mallet. The lid of the furnace should have a hole in it, so that the lid of the crucible may be removed to stir it and inspect the contents without removing the lid of the furnace. The great thickness of the furnace is to make it retain heat. If a thinner one be used, it should be enclosed in a large cylindrical pot of sheet iron, and packed well with some non-conducting substance, such as fossil meal (Kieselguhr) or asbestos. The gas flame should be admitted into this furnace tangentially so as to cause a vortex of flame. Gas may be introdnced through a piece of 1 inch gas tube. The air may be brought in through a piece of ½ inch brass tube held centrally in the iron gas pipe by means of three studs, and passing out at the other end of it through a collar furnished with leather. Its nozzle should be about ½ inch behind the end of the iron gas tube, which should just project into the exterior of the furnace, and thus be well removed from the heat. It is held in position by a casting of metal furnished with six screws, and bolted on to a strap of iron put round the furnace-body.

This plan is similar to that of Fletcher's new cyclone furnaces, but they are made with too thin walls, which causes loss of heat.

A blower called Roots' blower is frequently employed, but I find that it causes a great loss of power. The foot blowers of indiarubber supplied by Fletcher constantly get out order. I prefer the French leather foot blow enclosed in an iron cylinder. One of the No. 2 size, can be easily driven by a one-si horse-power dynamo. The dynamo ma about 1,200 revolutions per minute wl working, but is geared down so as to m about twenty strokes of the pedal per mini and this gives a very powerful blast, m than enough for the furnace. A good supply of gas is needed through a ¾-inch pi Such a furnace uses 20 cubic feet of gas hour. It becomes red-hot in about six minut and will easily melt cast-iron. It may used, of course, for all sorts of metallurgi operations. Instead of gas for fuel, petrole may be employed. In this case it should allowed to drip on to a gauze put in fron the blower, so as to be blown into the furn in the form of fine spray. If the furn becomes damaged, all that is necessary is patch it up with some fireclay mixed w water to a paste, to which a little water-gl is added. This prevents it from splitting. water-glass cannot be got, some borax may used to mix with the fireclay. A cruci supported on a suitable stand, or block of f clay, should be warmed gently, and then ingredients of the flux introduced into it. T would be—

Silica	3 parts.
Red lead	from 2 to 3 part
Calcined carbonate of soda..	1 part.

For a hard enamel, only 2 parts of red l would be put in; for a soft enamel, 3 pa About 2¾ parts of minium makes a good enamel.

A crucible 4½ inches high and 3½ inc diameter across the mouth holds about grammes, or nearly 2 lb. of melted dense fl

The materials must be finely powdered well mixed, and should be introduced into furnace through a small wide funnel by me of a spoon. Both spoon and funnel should provided with long handles. After the ebullition is over and the mass sinks do more and more material should be added the crucible is full. A steady heat should kept up for about fifteen hours. The glass become limpid and clean in about two ho but the long heating is necessary to mak thoroughly uniform. Glass made from materials which is only exposed to two or t hours' heat will crack when used as enar When the enamel is ready, it will draw easily into long threads. It should be pou

upon a slab of iron about a quarter of an h thick which has a trace of grease on it. poured over thin iron plate, it will make it hot and stick.

should never recommend the enameller to ke his own flux. Excellent dense soda flint ss of a specific gravity about 3·5, and conning about 45 per cent. of oxide of lead, can bought from the makers of optical glass, d nothing better can be desired. Messrs. ntois, of Paris, make such a glass, as also Messrs. Chance, the famous English makers. t, for reasons already given, soda glass ould generally be used, not potash glass. It sts from 3d. to 6d. a pound. This is dearer n the usual price for the commoner kinds of it. By using such glass as this as a foundan, enamel can easily be made with two or ee hours' heating, but it is improved by ger exposure to a moderate heat.

As I have said, raw materials take a long ating before they incorporate. This is espelly true of silica and alkalis. If silica has en well united to the alkali, lead can be soon lted into the compound, and will dissolve d make a durable glass.

When flint glass comes from the makers, it in lumps about the size of a nut. It may be ught ready ground, but is often full of chips iron. It is not difficult to grind it for oneself. For this purpose nothing is better than a all edge runner mill. The stones may be all, but the weight hung upon them should at least $1\frac{1}{2}$ cwt. on each runner. They ay be driven by a quarter horse-power namo. They should be made of the hardest ottish granite, and run at a rate of about teen revolutions per minute on a bedstone of e same material. A glass bell-jar with a le in the top will serve as a cover, and rmit the introduction of the glass, which ould be broken up on a slab of granite to e size of peas. It falls down a funnel, hence a pipe conveys it under the runners. is not desirable to grind the glass too fine, r in that case the lead is apt to become duced. It is amply sufficient if it passes rough a sieve eighty meshes to the inch.

In this way powdered flux can be obtained, ich can be used both for coating plates and so for making coloured enamels. There is, wever, a danger in melting up glass so avily charged as this with lead that the lead ould become reduced, especially if the glass s been finely ground. To obviate this nger, 2 per cent. of nitrate of potash in wder may be well mixed up with it. The colouring matters may now be added. These consist of metallic oxides. It is not in most cases necessary, nor in some desirable, that the metals should be added in the state of oxide. On the contrary, almost any salts of the metals will do, such as carbonates or nitrates, for the acids they contain will generally be expelled at a red heat and replaced by silicic acid.

It is not desirable to use sulphates, for on fusion the sulphur is given off, and this is apt to combine with the lead and form sulphide of lead, a heavy black substance. The sulphur also is apt to give a yellow tone to the enamel.

In many cases salts of the metals dissolve more easily than the oxides. Thus, permanganate of potash is better than oxide of manganese, and nitrate of copper is better than copper oxide. The salts may be dissolved in water, and the powdered flux wetted with it, well stirred up to diffuse the salt, and then dried. The nitrate of potash may then be weighed out and added, the mixture well stirred together, and then melted.

Some colours may be made by a much simpler process if the metallic oxides on which they depend are very soluble. Thus, turquoise copper can be made by melting up a crucible full of lumps of dense flint, and then stirring into it about 4 per cent. of dry powdered crystals of nitrate of copper. Bichromate of potash can also be used in this way. So also can permanganate of potash, but it requires a good stirring to dissolve it. The advantage of this plan, where practicable, is that the composition of the dense flint is as little as possible interfered with, and the resulting enamel is therefore more tough and homogeneous.

The materials used for colouring glass are as follows:—

Black sesquioxide of cobalt (Co_2O_3).—This, when united with silica and potash, forms the blue glass known as smalt blue. The oxide when pure is a very powerful colouring agent. Even one part in a thousand of glass gives a fine royal blue. The ore of cobalt is called "saffre," from which the word sapphire is derived. It contains a large quantity of arsenic, which makes the operation of roasting it dangerous. In consequence the German miners called it after the "kobolds," or spirits of the mines. Saffre contains about half its bulk of black oxide. The colour of cobalt is brightened by the addition of some alumina (*i.e.*, oxide of aluminium or clay). It is darkened by the addition of iron manganese or uranium. Phosphate of cobalt can also be

employed. One and a half parts of phosphate are equivalent to one of oxide of cobalt.

Black oxide of copper (cupric oxide, CuO) is the scale formed on copper when heated to redness in the air. It colours glass a light sea green. With soda glass its colour is more blue than with potash glass, and varies with the degree of heat at which it is melted. Greater heat produces a more green tinge. About 2 per cent. of it gives a fine sea green. It may simply be added in powder to a crucible full of melted glass. It is a treacherous colour, as it tends to make the enamel brittle. Another plan is to employ nitrate of copper by dissolving, say, 10 grammes of copper in nitric acid, then add 20 grammes of anhydrous carbonate of soda, or a corresponding proportion of ordinary carbonate. The mixture will strongly effervesce ; when the effervescence has ceased enough nitric acid should be added to convert all the soda into nitrate of soda. Make it up to 200 c.c. in bulk, and wet with it from 700 to 1,000 grammes of powdered dense flint glass ; dry it and melt. It gives a fine, somewhat greenish turquoise. The nitrate of soda serves to prevent the lead from being reduced.

Red oxide or suboxide of copper (Cu_2O) is used to give a red colour, either transparent or opaque, to glass, but is not employed by the enamel-maker, because gold serves the same purpose much better. (See farther on, under the heading "Gold.") When black oxide of copper is added in larger quantity, as say 6 per cent., and then, when melted, some iron filings are added and slowly cooled, we obtain the sparkling mass known as "aventurine." The colour of copper enamel can be modulated by the addition of oxide of zinc, oxide of cobalt, oxide of chromium, or oxide of uranium.

The oxide of iron most usually employed is the red peroxide or ferric oxide (Fe_2O_3) known as rouge or crocus martis. It dissolves with some difficulty in silica. When 5 per cent. of this is *dissolved* in glass it gives a sickly green colour like bile. If simply mixed into the melted glass in large quantity, say 20 per cent., so that it is not dissolved, it affords a red opaque enamel like red sealing-wax, which is useful for many purposes. Rouge is generally made by calcining sulphate of iron. The red oxide of iron used as medicine is obtained by precipitating a salt of iron with ammonia. So that for making opaque red, rouge is preferable ; but for dissolving and making green, the precipitated red oxide of the druggists is the best.

A fine green may be made of a union o[f] precipitated iron peroxide and chromate o[f] potash, but the shorter way is to procur[e] chromate of iron, of which there are two sorts the dark and the light, which both serv[e] equally well.

About 3 per cent. of chromate of iron gives t[he] enamel a fine bottle-green colour, the shade of which can be modulated by the addition o[f] copper, cobalt, and uranium.

Black binoxide of manganese (MnO_2) give[s] a reddish purple. About 4 per cent. is a usef[ul] proportion. When in the crucible, oxygen i[s] disengaged, which causes the ingredients t[o] foam up ; hence the crucible should only b[e] filled one-third full at first, and the rest adde[d] gradually. Manganese is called in Germa[n] "brown-stone ;" and by the French, "peridot," after a town near Limoges, where it was found It is not easy to get good oxide quite fre[e] from iron.

When manganese is melted up without an[y] oxidising agent being present, or when it i[s] long heated, especially when it contains a littl[e] iron, it takes a reddish tone. The violet hue i[s] obtained only when the manganese is kept wel[l] oxidized with nitrate of potash.

Mixed with rouge manganese forms a fin[e] warm reddish brown, and is the only sort o[f] transparent red which the old masters pos[-] sessed, at least till gold-red was discovered the date and introduction of which seem [a] mystery.

Manganese gives with cobalt a bluish violet and with cobalt, iron, and copper it gives [a] deep black.

Instead of using this oxide of manganese w[e] may employ one and a half times the amoun[t] of permanganate of potash, which may b[e] dissolved in water, and the powdered flu[x] wetted with it, and then dried. This gives [a] very fine colour, and I think it is preferable t[o] using the oxide, for it is much more pure.

Some sorts of binoxide of manganese ar[e] black, some brown, but their quality is th[e] same. It is a difficult pigment to get pure and for fine colour purity is desirable.

Yellow (so-called) *sesquioxide of uranium* or what is really uranate of soda, is a mos[t] useful colour. Its only drawback is that it[s] colouring power is feeble. It takes 15 pe[r] cent. to make a full yellow. It mixes we[ll] with copper and chromium to form brilliar[t] greens, and with gold it forms a splendi[d] orange colour, but its use requires some pre[-] cautions.

If simply mixed with powdered dense flin[t]

ith the usual 2 per cent. of potash, it gives a ottle-green, which, after many hours of heat-ıg, becomes at last a dirty yellow.

In order to get the canary colour out of ranium, it seems necessary to keep it re-uced, and therefore the best way of making is to heat together some ordinary flint glass, uch as Chance's potash flint, 10 per cent. f minium, from 10 to 15 per cent. of uranium, nd 2 per cent. of potash. This in about an our gives a fine yellow.

It is important to get good uranium. The rand known as "Joachims-thal" is the best. t is of a fine deep yellow, almost an orange, nd can be got from the vendors of chemicals r china manufacturers.

Chromium.—If employed in the form of the reen sesquioxide (Cr_2O_3), it gives a fine paque green. This is due to the fact that he sesquioxide dissolves in glass only with reat difficulty. And most of it therefore re-ıains suspended. If, however, yellow bi-hromate of potash is used ($K_2C_2O_7$), it is ll disolved and gives a bilious green. When large quantity, such as 8 per cent., is sed, the glass becomes surcharged, and the hromium crystallises out, producing green venturine.

But chromium is best used for greens in ombination with iron, as above described.

Nickel is a valuable colouring agent. Car-onate of nickel ($NiCO_3$), a green powder, nparts to the glass a fine cold sepia brown; om 2 to 3 per cent. may be employed.

Gold.—Great mystery has been made as the production of crimson from gold, and ll sorts of accounts are given in the books f its manufacture. In some the tedious pro-ess of making purple of Cassius is recom-ıended, which I will not detail here as it is f no use to the enameller. I do not, how-ver, know any book in which a sufficiently etailed method is described to enable the orkman to succeed with certainty. The one give will therefore be the more valuable be-ause I have tried it so many times as to be ertain of its success. To make the gold-ed it is essential that some raw minium hould be present. Hence then it will not o to begin with dense flint. We must egin with a light flint. Ordinary powdered ght flint serves admirably for the purpose, but should be a soda flint, or heavy soda flint can lso be employed.

Soak a kilogramme of it in 300 cubic centi-etres of water, in which 1 gramme of chloride gold has been dissolved; mix well. The ordinary chloride used for photography does very well. Add 250 grammes of minium, and 100 grammes of yellow uranate of soda, or, as it is usually termed in trade, "orange oxide of uranium." Add also 20 grammes of nitrate of potash in powder. Put these all in a basin and mix them well and evaporate till they are dry. Then triturate them all together in a large mortar till they are perfectly mixed.

Heat a crucible in the furnace till it is of a bright red, and then fill it with the powder. Put on the lid and get up a sharp heat for half an hour. The mixture first turns a light opaque pinkish-brown, then in about 15 minutes it fuses into a clear canary yellow, which deepens during the next 15 minutes. It may be stirred once, but stirring is apt to cause the lead to be reduced, and if the preliminary mixing has been well done it is not necessary. Then take out a specimen on the tip of a rod, let it cool and reheat it. If on heating it appears orange, the operation is near com-pletion, but the heat must be continued till in about 35 or 40 minutes on reheating the glass becomes of a blood red. The contents of the crucible may now be poured, and will be of a bright full canary yellow. The pieces may be used in this way, and will turn red on firing, or else bits may be held in the tongs in the muffle furnace till the colour comes, or put on bits of platinum and reheated.

But the critical moment must not be lost, for if the operation be continued too long, the glass becomes of a light brown semi-opaque tint, and it is then almost impossible to get it back again. The tint will be fire-red.

Instead of the uranium, 2 per cent. of black protoxide of tin or stannous oxide (SnO) may be added. In this case the colour, instead of being a fire-red, will be of a more purple tone. A much longer period of heating is however required.

These two colours are most valuable for enamelling.

It may be a matter of some surprise that so short a heating produces the result. It seems however true that, though alkalis take a long time to unite with silica, lead is soon and easily dissolved in glass.

I have done many enamels with gold made as above described. They are very brilliant, and have never split. On the con-trary, they seem remarkably elastic and stable.

The reader must also be cautioned against statements in several manuals such as that gold-red cannot be made with glass containing

lead, or again that it cannot be made except with glass containing lead, or again that it cannot be made exeept with borax. All these statements are false. In fact, it is possible to make gold-red almost anyhow, if only the exact proportion of the ingredients is hit off. And these exact proportions seem in each case to be a matter of experiment.

About ·05 per cent. of black oxide of cobalt added to the gold and tin will give the red a violet hue, but so like that of manganese as not to present any particular advantage over enamel made with manganese.

On white these reds made with gold give a fair effect, but their chief use is upon gold paillons, when they give a glorious colour. Iron can also be employed as what I may call a precipitant, but its effect is not so uniform. In fact, nothing equals uranium. It acts best when about 15 per cent. is put in, and the resulting glass is beautifully smooth and workable.

Copper may also be used to give a deep red colour with the use of tin. But at least 5 per cent. of red oxide of copper is required, otherwise the glass becomes transparent green. The colour comes, like that of gold, upon reheating. The large amount of copper required makes the enamel too deep for use. It is asserted that some German firms have succeeded in making thinly-tinted red glass with copper oxide. As a rule, however, it is only used for "flashing" glass, that is to say, in a very thin layer on the surface of transparent glass.

In the Middle Ages, copper was much used in this manner.

During the French Revolution a large number of the finest church windows in France were destroyed in the belief that the red glass was rich in gold, but the chemists having shown that it was made with copper, the work of destruction was stayed.

If a very large proportion of red oxide is put in, and the heat not made too great, the red oxide is melted into and suspended in the glass, and a rich, crimson, opaque enamel is obtained.

Tungsten can also be employed to strike down the red colour in copper and gold, but it seems to possess no particular advantages.

I may add that the above-suggested theory of metallic precipitation, akin to the sort of action that goes on in the development of platinotype prints, is a mere hypothesis, for at present the chemistry of the coloration of glass with gold and copper is not understood.

Iridium oxide is an intensely black powde It colours glass most powerfully; ·03 per cen of it gives a good grey. But its greatest us is, when mechanically mixed with 2 to 4 part of flux, as an opaque black pigment. It serve then the same purpose as Indian ink does o paper.

Selenium is a black, brittle substance, some what akin to sulphur. If pounded up an mixed intimately with pounded glass an about 2 per cent. of nitrate of potash, it give a fine yellow colour. But when a reducin agent is present it gives a rose colour.

Opaque white is made by melting whit oxide of tin (stannic acid) with powdered glass The tin is not dissolved in the glass, but sus pended in it like a pigment. But the tin ha so strong a reducing power that, if a mixtur of powdered dense flint glass and oxide of ti were melted together, the lead would becom reduced and the mixture blackened. The ti must therefore be introduced by an artifice This can be done by taking light flint an mixing it with sufficient minium to change i iuto dense flint, and at the same time introduc ing the tin, for the minium keeps the mixtur oxidised; a little nitrate of potash might als be added for the same purpose. Thus if w take of powdered flint, 6 parts; minium 1 part; white stannic acid, 2 parts; we shal get a white very well adapted for grisaille. I will be so hard as to be almost impossible t pour, and must be dragged out of the crucible But it is a splendid material for use of grisaille It is, however, almost too hard and devoid c polish, and if employed for doing grisaille must be glazed over with flux when finished To soften it is an easy matter by introducin some borax. This will bring it down to an refined degree of fusibility, till it is soft enoug to be useful for enamelling watch faces, or an other similar purpose. The lead and tin ma also, at least in part, be introduced into th enamel in the form of "putty powder."

Without the use of some borax it is almos impossible to get a fusible and yet brillian white.

Nothing but a very hard white is of use fo doing grisaille. Messrs. Emery, the colou makers, make an excellent white, known a No. 100, for use by china painters, which I ca recommend strongly for grisaille, as it stand the fire well in the half-tones.

The following recapitulation of the metho of making some of the most useful ordinar enamels may be useful. In each case soda flint glass is used as a foundation, ordinar

nt flint, such as is employed for table glass, ng used if a hard enamel is wanted, and ise optical flint of about 3·5 specific gravity ng used if a softer and more brilliant enamel lesired.

n most cases the addition of a little nitrate potash is desirable, to keep the lead from ng reduced; 2 per cent is on the average ficient. The longer the heating the better result; three or four hours (except for gold) the least that should be given. On a large ile, with big crucibles, the time required will much longer.

Grass green.—Melt powdered flint glass h three per cent. of chromate of iron, and 2 r cent. of nitrate of potash. Or, mix wdered flint glass with 1·6 per cent. of black de of copper, ·8 per cent. of bi-chromate of tash, and 2 per cent. of nitrate of potash.

Dark rifle green.—The usual quantity of rate of potash, and from 10 to 20 per cent. nitrate of copper.

Turquoise.—This must be made with soda ass, for potash glass produces a bluish green e a faded turquoise. In a crucible of melted ass stir 1¼ per cent. of black oxide of copper; will dissolve easily. Or 2 per cent. of nitrate copper in powdered crystals may be used.

A pale sky blue.—Powdered flint with 2 per nt. of nitrate of potash, and ·2 per cent. of or-spar.

Iron blue.—To the materials for turquoise, d ·025 up to ·05 per cent. of black oxide of balt.

A deep royal blue.—Powdered flint glass th the usual quantity of nitrate of potash, d 2 per cent. of black oxide of cobalt.

A medium royal blue.—The same, but th ·6 per cent. of oxide of cobalt.

A light royal blue.—The same, but with per cent. of oxide of cobalt.

All the above may be toned to a more sober ie by the admixture of a little iron. The odern blues are rather brighter than the icient, because the cobalt now obtainable is irer. Instead of iron, if about 5 per cent. of llow oxide of uranium is introduced, the me effect will be produced.

Black.—Cobalt, 3 per cent.; manganese, 2 r cent.; brown chromate of iron, 2 per cent.

Antique red.—Manganese, 2 per cent.; uge, 2 per cent.; nitrate of potash, 2 per cent.

Purple.—Permanganate of potash, 4 per nt. to 8 per cent.; nitrate of potash, 2 per nt.; or, binoxide of manganese, from 3 per nt. to 6 per cent.

The permanganate may be simply stirred into a crucible of molten glass, in which case no nitrate of potash need be employed, but it requires a good stirring to disseminate the colour throughout the glass.

Brown.—1 per cent. of green carbonate of nickel; 2 per cent. of nitrate of potash.

Dove-coloured grey.—1·3 per cent. of black oxide of manganese; ·05 per cent. of bichloride of platinum in crystals.

Slate grey.—Bichloride of platinum, ·05 per cent.; nitrate of potash, 2 per cent.

Fire ruby (see "Gold," above).

Ruby (*blood colour*). — Made as before described; ·1 per cent. of chloride of gold, 2 per cent. of protoxide of tin, and 2 per cent. of potash.

Claret colour.—As for ruby, but with the addition of ·05 per cent. of cobalt. And note here that when such small quantities of colouring matter are to be added it is best done by adding the requisite amount of powdered glass coloured with cobalt, or whatever else it may be wished to add.

Canary yellow.—15 per cent. of uranate of soda; 2 per cent. of nitrate of potash.

A fine orange yellow.—4 per cent. of metallic selenium; 2 per cent. of nitrate of potash.

The selenium must be very finely powdered, and then with the potash well incorporated up with the pounded glass, for selenium, like sulphur, is very volatile.

After making each batch of enamel it should be tried. This is best done by preparing a copper label bulged like a plaque, and with a a hole in it, and of dimensions say 1 inch by 2 inches. This should be covered with any common white and fired, and then with a pretty thick coating of the colour and fired. While it is just so hot that it can be touched, it should be put under a tap of cold water, and if it does not crack it may be pronounced sound. Its composition should then be indicated on a gummed label pasted on the back, and the whole used as a label to the jar containing the enamel. It thus serves as a colour index, a record of composition, and a test of the resistance and durability of the enamel. A bad enamel will generally crack in the course of a month after it is made, but I never knew one to go in this way that had stood the water test.

Upon the whole, I hardly recommend the amateur to be at the pains to make his own enamels. They can be got of excellent quality, but of the harder sort, from Soyer, Rue Chapon, in Paris. The prices vary from four francs a

kilogramme upwards. Messrs. Millencent, 5, Rue de Chautepoulet, Geneva, make some very fine opalescent enamels, but charge the absurd price of about twenty francs a kilo. for all of them, even for common cobalt blue.

SEVENTH ORDINARY MEETING.

Wednesday, January 17, 1900; SIR JAMES CRICHTON BROWNE, M.D., LL.D., F.R.S., in the chair.

The following candidates were proposed for election as a members of the Society :—

Aberdare, Lord, Duffryn, Aberdare.
Arden, Edwin Cooper, Liddel-bank, Canobie, Dumfries-shire.
Bliss, Sir Henry William, K.C.I.E., 13, Chesham-street, S.W.
Brophy, Prof. A. Finn, Technical-college, Leonard-street, E.C.
Caird, Captain Lindsay Henryson, Woodbourne, Bushmead-avenue, Bedford.
Carter, His Excellency Sir Gilbert Thomas, K.C.M.G., Government-house, Nassau, Bahamas.
Charlton, William, J.P., Egerton-bank, Higher Openshaw, Manchester.
Cockerell, Douglas, 6 Denmark-street, W.C.
Couper, James, 22, Aislibie-road, Lee, Kent.
Edwards, William Rowland, Rosedale, Weybridge.
Farmer, Charles, 12, Wood-street, E.C.
Jackson, William Frederick, Mount-view, Sheffield.
Krause, R. Howard, I. Ebendorferstrasse, No. 10, Vienna.
Lawrence, Joseph, Oaklands, Kenley, Surrey.
Molloy, Ambrose James, Bangalore, India, and care of Messrs. Grindlay and Co., Parliament-street, S.W.
Parkinson, J., Canal Ironworks, Shipley, Yorks.
Phillips, Joseph, 30, Hart-street, Altrincham.
Ridge, Joseph, Tudor Works, Sheffield.
Robins, Joseph George, 84, Trinity-road, Wood-green, N.
Shippard, Sir Sidney Godolphin Alexander, K.C.M.G., D.C.L., M.A., 15, West Halkin-street, S.W.
Thomson, Alexander, Widmore-house, Bromley, Kent, and 27, Mincing-lane, E.C.
Upsher, Henry Morris, J.P., Sheringham-hall, Cromer, Norfolk.
Wagle, Nilkanth B., B.A., 28, Castletown-road, West Kensington, W.
Wallace, Charles William, 6, Langford-place, St. John's-wood, N.W.

The following candidates were balloted for and duly elected members of the Society :—

Aird, Kenneth, 35, Bryanston-street, W.
Betts, William Henry, 2, Gray's-inn-place, Gray's-inn, W.C.
Crowden, Charles T., Motor Works, Leamington.
DeCastro, John Paul, Ford-house, Redruth, Co wall.
Mowbray, Sir Robert Gray Cornish, Bart., 10, Li Stanhope-street, Mayfair, W.
Walker, Sydney F., Bloomfield-crescent, Bath.
Whipham, Dr. Thomas Tillyer, 11, Grosvenor-str W.

The paper read was—

VENTILATION WITHOUT DRAUGHT

By ARTHUR RIGG, C.E.

There is nothing people take so little ca of as their own lives: and those who wo never offend against the laws of their count which are of human origin, constantly outra the laws of health, which are Divine. T sentence on one may be a temporary disco fort; but the sentence on the other is disea and death. Already science has done mu towards removing evils and prolonging li for example, in modern systems of sewage d posal, and the supply of pure water: but corresponding progress can be claimed such sister branches as the removal of ca bonic acid, &c., from air that has be breathed, and the supply of pure air to r place it, both of which operations are includ in the term "Ventilation."

As usually practised, ventilation bears a f closer relationship to Art than it does Science; and although many exhausters ser as very ornamental finials to a roof, yet th produce draughts, and other evils, worse th those they are intended to cure. Ventilatio contemplated as a science, will include warn ing or cooling an ample supply of air, and tl washing, diluting, or removal of deleterious i gredients contained in air which has be breathed. Although many positive statemen have been made on the subject, without muc foundation in fact, and many "patent" vent lators exist, yet very little of a scientif character is obtainable; perfection seems long way off, and a proper reliable system ca hardly be said to exist. But with the pure medical side of the question it is differen The modern science of bacteriology explair much that was once mysterious, and it show conclusively that, for the maintenance of healtl a supply of fresh air to breathe is equally in portant, if not more important, than a supp of pure water to drink; and, fortunately, n possible conflict of opinion can occur as to th source from which such a supply of fresh a can be obtained.

Perhaps the most convincing testimony as the inestimable value of pure air was that iven during a meeting held in Marlborough-ouse on 20th December, 1898, under the esidency of H.R.H. the Prince of Wales. his meeting inaugurated a National Associa-on for the Prevention and Cure of Consump-on, and his Royal Highness presided in der to prove his deep interest in this very nportant subject. In the course of an inter-sting speech he referred to the sanatorium at alkenstein, where no local cases of consump-on exist. As chairman of this Association, ir William Broadbent next pointed out that iodern improvements, subsoil drainage, im-roved hygiene, and greater attention to venti-ation, had reduced the cases of consumption by o per cent. during the last half century; and bservations in sanatoria for the open - air eatment of tuberculosis, showed that pure ir, more than anything else, promoted its ure.

In other directions, the effect of vitiated air roduces terrible evils. In a report by Dr. orrop on Lancashire factories, published by he *Daily News* of 1st January, 1899, after escribing the sad deterioration of children hrough working in a reeking hot and foul tmosphere, he says:—"The same causes hich produced the terrible evils of 100 years go are, though modified, still in operation, nd may, in a minor degree, be expected to roduce the same effects." This slight im-rovement is due more than anything else to entilation, which, he says, has been much im-roved in recent years.

Mr. Osborn, H.M. Inspector, confirms this pinion, by saying:—

"At present, our workpeople are breathing over nd over again the same air, vitiated with gases more r less impregnated with dust, and other impurities, nd every hour appreciably deprived of blood-purify-ng and life-sustaining properties. The natural con-equence is the development of anæmia, dyspeptic, nd phthisical tendencies, and low states of vitality, redisposing to epidemics of zymotic disease."

In a low part of New York, Dr. Guerard ound that out of 663 houses, during three ears, there were 541 cases of tuberculosis in 48 of these houses (says the correspondent of he *Daily Chronicle* for 17th January, 1899), nd he recommends the destruction of these nfected houses, as the only method for pre-enting the spread of this disease.

The ventilation of the Houses of Parliament as been a perennial cause of criticism; and, lthough committees have reported, and celebrated names have been invoked, yet the ventilation in this important building, and in the committee-rooms, remains to the present day a subject of controversy.

Regarding the air that members of Parliament breathe, Mr. James Keith's report in 1884 stated that the then system of ventilation and air supply was bad: insufficient air supplied in summer, and he pointed out that the air in winter is debilitated by being passed over hot steam pipes; that sewer gases found their way into the committee-rooms, and that fresh air admitted into both Houses, and the division-lobbies, through gratings in the floor, is impregnated with dust. Great improvements have been made since that date, but this fundamental question is the subject of much difference of opinion.

Regarding the new smoking-room, a correspondent of *St. James's Gazette*, under date 6th January, 1899, writes as follows:—

"The new smoking-room is not nearly so pleasant as the old one, as it looks into a small court, in which there is, I suspect, a pretty constant supply of stagnant if not foul air. The apartment is suppposed to be ventilated in an especially ingenious manner; which doubtless commends itself to those who like rapid transitions from the climate of Greenland to that of Central Africa."

This seems to indicate room for improvement! though no arrangement will satisfy everybody.

Under the heading "Draughts in Theatres," a correspondent of the *Daily Telegraph* writes, under date 31st December, 1893:—

"The ventilation of the stalls—ventilation, I may truly say, with a vengeance, for it is a common thing in many of the best theatres to see the occupants of this part of the house, sitting in overcoats, with the collars turned up, and only deterred by a fear of the 'gods' from putting their hats on! . . . . This morning, I have most pleasant reminiscences of a very cheerful night's amusement, but I have also rheumatism in my shoulders, a bloodshot eye, and a cold in my head."

The "Academy headache" is well known, and the *Builder* has a very decided opinion in regard to the Royal Academy Exhibition. It is that:—

"The rooms are most inadequately ventilated, and this is a matter which ought to be seen to. Every one knows that a visit to the Academy, during the crowded days of the earlier part of the season, is one of the most fatiguing forms of recreation that one can be exposed to, and 'Academy headache' and 'Academy backache,' are almost recognised forms of debilitation. Those who have the opportunity of

comparing experiences, when the rooms are comparatively empty, as on 'Varnishing' day and Press day, can bear witness that these disagreeable results do not arise from a visit to the Academy on those days. The debilitating effect, so much complained of by the ordinary visitor, is mainly the result of bad air—insufficient oxygen for the consumption of the crowd. There are several architects in the Academy: are they too much taken up with Art to see that the rooms are properly ventilated ?"

These strictures were made by the principal architectural paper of the country, a few years ago, but the "Academy headache" is just as it used to be; and it reminds us annually that there are still several architects in the Academy.

Railways and carriages are just as badly ventilated as buildings; and matters seem to have reached a climax on the Metropolitan Underground Railway, where no really serious attempt has ever been made to supply ventilation, by the same means as renders coal mines, a mile away from the shaft, as well ventilated and supplied with air as fresh as that in this room. Nobody can blame the talented engineer who arranged the Metropolitan Railway; he did not foresee that its usefulness would be enhanced far beyond all expectation, and that the mild system of ventilation provided would become unequal to coping with a vastly increased number of trains. But now that this increase is a known fact, it does seem a pity that the directors should relinquish an unfought battle, giving up in despair any attempt at ventilation, although there is hardly a mining engineer in the kingdom who could not carry out an efficient system, just as he does under the far more difficult conditions of coal mining. The substitution of electric traction for steam power, will probably enable the present ventilating arrangements to act sufficiently in the roomy tunnels, called the Underground Railway. But underground electrical railways are not always models of perfection in the matter of ventilation. In a letter to the *Daily Mail* of 24th December, 1898, the writer describes his experiences on the City and South London Electrical Railway thus:—

"Nothing could be more disgraceful than the overcrowding on the City and South London Electric Railway. Between the hours of 8 and 10 a.m., and 5 and 7 p.m., each carriage is as bad as the Black Hole of Calcutta—a packed mass of human beings, as many standing as sitting; sometimes between 60 and 70 in a carriage. When the train starts from King William-street, the effect is awful; and on arriving at the end of the journey, you feel utterly exhausted through breathing the bad and used-up atmosphere."

Thus it appears that engineers cannot always throw stones at architects in the matter of perfect ventilation.

The new Law Courts serve as a fine example of imperfect ventilation and of deplorable arrangements for housing their engineering requirements throughout. It was originally supposed that cold air would be so accommodating as to enter only from below, while warm and supposed vitiated air would be equally complaisant and go out only by openings in the ceiling.

But the air persisted in following its own natural laws, and not the architect's expectations. Draughts of cold air poured down the upper exits upon the heads of Judge, jury, and counsel, while a corresponding series of variations below caused the greatest discomfort to those standing in the draughty passages. In the end, the roof was matchboarded, and ranges of hot-water pipes provided to warm the air therein, so that if air was so misguided as not to follow its intended course, it should at any rate be felt as warm air descending, and not as cold air. Under these curious conditions, as might be expected, the inlet of fresh air is spasmodic and unreliable.

The results, in spite of all that has been done to force air out of its natural direction, is still unsatisfactory; for in January, 1899, the General Council of the Bar appointed a committee to discuss the practice inaugurated by Lord Brampton of long sittings. The effect of so many hours spent in the *vitiated atmosphere* of the Courts of Justice was stated to be very destructive to the mental and physical vigour of Bench, Bar, witnesses and litigants; and it was shown that no man can do his work well under the trying conditions of headache and semi-suffocation!

In an account given in *Lloyd's News* of 12th November, 1899, of the Elizabethan Players' performances at the Theatre of the London University, the reporter says that—

"The society, despite bad acoustic properties and a *direful lack of ventilation*, managed after their own fashion to represent Shakespeare's 'Richard III.'"

It would be easy to compose an encyclopædia full of illustrations, bearing upon the utter neglect of any serious attempt to supply a due amount of fresh air to audiences in theatres, congregations in churches, assemblies in public halls, or to the inhabitants of private houses. Whether we ride in a cab, with shut windows, or travel by sea, or take our journey in a railway train, or pack into an omnibus: under all these circumstances and innumer-

others, which might be quoted, the same t of proper ventilation is apparent. Not do men, women, and children suffer esses and die annually of preventable ase, but the very animals in the Zoological dens used to perish more through conption from breathing foul air than from er forms of disease: things are better now. lthough improved sanitary arrangements e raised the average duration of human beyond what it used to be half a century , and done this by cultivating a better owledge of the laws concerning health, it is fectly certain that there is no such thing as lity, and all our applications of science are ceptible of improvement. Ventilation, conered as a science, under the usual existing ditions is entirely in its infancy, and a le research into what has been done and tten in regard to this subject, cannot fail to interesting and instructive. What has been tten does not go very far beyond the advoy of certain exhaust ventilators, of more or s artistic design, intended to be fixed on the f, to extract warm air from the upper regions assembly-rooms, theatres, &c.

Probably the Society of Arts has done more n any other public body to investigate and tle the general principles on which ventilation angements should be conducted. In 1872 offered gold medals with prizes of £50 for best fire-grates for warming and ventilating oom, also for the best kitchen-range or gasve fulfilling the same conditions. Experints on the grates sent for competition were rried out at considerable cost, under the pervision of a very influential committee, o, in the end, were unable to apportion a ward to any of the competitors, as none of e fireplaces fulfilled the conditions laid down.

Perhaps the most interesting paper on ventition that can be found in the *Society of Arts urnal*, is that by the late Mr. D. G. Hoey, ad on the 31st May, 1889. The earlier porn of this paper is historical, being mainly an count of ventilation as practised in ancient ome, and during the Middle Ages in Europe. e refers also to the ventilation of mines, and votes much attention to the arrangements for pplying air to the Houses of Parliament. his paper also contains a record of schemes d failures, and he ends by recommending (on ge 613):—

"A dado, about 3 feet high, fitted, at conveniently ailable parts around the room, with a narrow space tween the dado and the wall; and on the top of the do wire gauze or perforated metal is fixed, in an inclined position, so that articles may not be placed upon it to impede its action. The fresh air is introduced into the dado space at a low level, and in a lateral direction, to promote diffusion through a number of inlets from the outer atmosphere along the whole line. . . . . The total space enclosed by the dado, forming a fresh air-channel or reservoir, being very much greater than the total area of the inlets from the outer atmosphere, the outer air coming into this extended space, and entering in a lateral direction as explained, thus loses its initial velocity; spreads itself slowly over the interior of the reservoir, gently percolating through the innumerable interstices in the wire gauze or perforated metal on the top; permeates the atmosphere of the room by imperceptible diffusion at the low level, at which it immediately yields an abundant supply of oxygen to be breathed by the occupants."

In conjunction with his inlet arrangements, he provides a sort of chimney or flue, with an opening in the room at a higher level, near the ceiling, to carry off the warm air which gravitates there; and he also provides (where necessary) apparatus for washing or cooling the air, during summer, besides warming apparatus for winter use.

The general arrangements described by Mr. Hoey, illustrate a system of ventilation which, in its most essential features, bears a considerable resemblance to that adopted in the meeting-room of the Society of Arts, which is illustrated by Fig. 3 (p. 191), and will be described later on. Although the results of this apparatus may be somewhat imperfect, and at times contradictory, it must be remembered that similar evils accompany all ventilating arrangements not of a positive order, that is, not controlled by sufficient force to render their operation independent of irregular atmospheric currents.

Another paper on ventilation, containing much interesting information, is that by the late Mr. W. W. Phipson, on the heating and ventilating apparatus of the Glasgow University. This paper was read before the Institution of Civil Engineers on 3rd December, 1878, and may be found in vol. lv. of their "Transactions," page 124.

Before the University buildings were erected, a committee was appointed, whereof the present Lord Kelvin was chairman. They met to decide upon a suitable system of ventilation, and the following conclusions were reached among others:—

1. Foul air to be removed from below.

2. Inlets for fresh air should be high up, and distributed around the circumference of the room.

3. The total supply should be ·6 cubic foot

per sitting per second (an amount which was found to be far too much).

The supply of fresh air from above and the withdrawal of foul air from below, although contrary to received popular opinion, was not new, as it was advocated by the celebrated General Morin, and was carried out at the Conservatoire des Arts et Métiers, Paris, not, however, by General Morin himself, but by architects and builders, who perhaps not understanding the innovation, neglected the precise instructions given, so that considerable draughts were found at the lower exits, probably from cold air entering where vitiated air was intended to depart.

Where, however, the ventilation, as at the Trocadero Palace, in Paris, was controlled by a fan (11 ft. 6 in. diameter, with eight blades, making ten revolutions per minute), the downward system of ventilation used in summer was found to be very satisfactory in its action.

When the Glasgow University buildings were completed, it was found that warm air, entering at about the middle height of the rooms, flowed away through the upper outlets, so it became necessary to open the windows in winter to provide air for crowded classes. Moreover, the underground air-passages and sewers had been placed in such inconvenient proximity that damp air came into the class-rooms, accompanied too often by an "ancient fish-like odour," which eventually caused the whole original system to be abandoned. Such results were unsatisfactory in the extreme, and during the discussion which followed upon the reading of Mr. Phipson's paper Professor Allen Thomson came to the philosophical conclusion that, so far as the experiment went it was a success, but that "the problem of ventilating and heating large buildings had not been solved;" while Professor James Thomson pointed out that no means had been provided for mixing the hot air with that which was cold and fresh; and Mr. Ismay found objections to the admission of fresh air at a high level, because it would mix with the foul air. A good illustration this, of the confused ideas which at present dominate the entire subject of ventilation!

Long, however, before any of these papers were written, namely, in 1864, the author's father, the Rev. Arthur Rigg, wrote a report upon ventilating the infirmary at Chester. Little can now be added to the descriptions of ventilating systems taken from five paragraphs in this report, which read as follows:—

"*Means for Controlling Ventilation.*—One of t means is usually resorted to for controlling t ventilation of rooms in which persons are *continua* resident. The most common is the extraction of by some of the many schemes for exhausting drawing air out. The other is, forcing air into t room. Although in each case fresh air is introduc and that which has been vitiated removed, yet t effects are so different that circumstances must d termine which plan is most likely to meet particu requirements.

"In the process by exhaustion, every crevi becomes an inlet for air, and there is thus at ea chink or crannie, a draught, hence the draughts ordinary dwelling-rooms, with fires which depend f the combustion of fuel upon the air of the roo Further, the intensity and character of the burni are continually changing the amount of air influenc by these causes.

"In the process by condensation, these crevic become outlets, and consequently there are n draughts from them."

The former is called the "vacuum," and th latter the "plenum" system.

Under the heading "Ventilation of Wards the report proceeds (page 14) as follows:—

"The whole of the air required for this purpo may be obtained from the west front grids. In ce tain directions of wind and states of atmosphere, th ventilation would be accomplished by simply openi the appropriate valves. On many days, however, th would not be the case, and no system of ventilati can be satisfactory which is not effective at all time and in any degree required. The following arrang ments are suggested to enable the authorities of th Infirmary to exercise complete control over th ventilation, irrespective of either the intensity direction of atmospheric currents—Two rotatin noiseless fans (one for each system of warmed piping should be placed with their central openings closed communication with the west front air grid The rotation of these, combined with the adjustme of the inlet of the air-ducts previously describe would ensure a uniform and duly proportioned supp of air to all or any one or more of the ward Whether in winter or summer, suitable air could l admitted, for whilst by the systems of piping requisi heat for winter is provided, there are means f partially cooling air in summer. Various plans f driving these fans might be suggested—as by th agency of water, weights, electricity, air, steam, ga animals, &c., &c. After carefully considering thes and similar respective sources of power, none seem likely to be so economical and efficient as steam."

The suggestion of fans driven by electricit at such an early date as 1864, seems a pro phetic vision of what was then non-existen but now well known, and common; and th remaining portions of this report are directl applicable to scores of ill-ventilated building

the present day. Although the plenum, or essure system, is generally recommended, t it is pointed out that the vacuum system ssesses certain advantages, when applied to ore-rooms, water-closets, &c.

A recent paper on the ventilation of tunnels nd buildings, was that by Mr. Francis Fox, ad before the Institution of Civil Engineers n 6th December, 1898. In this paper, much ttention is devoted to the want of proper ventiition in the Houses of Parliament Committeeoms, and Dr. Ransome is quoted as describig the air in those rooms as being charged ith "air sewage" of the vilest quality, ontaining, as shown hy the microscope, uantities of tuberculous and other dust. Dr. ansome contrasts the air in sewers, with its ·9 micro-organisms per litre, with schools naturally ventilated" and possessing 152 of uch organisms per litre.*

Returning to the paper read by Mr. Fox, he ondemns the admission of fresh air through loor matting in the Houses of Lords and Commons; he discusses the many failures to entilate large buildings, and concludes with he proposition that no large building can be uccessfully ventilated without the use of fans r other mechanical force, and he recommends he extraction of "foul" air from the top of he room or building, and the admission of resh air through a Tobin tube or other similar rrangement having its discharge some 5 feet above the floor.

It will be clear that from considerations of ealth and comfort, as well as from affecting he duration of life, the subject of ventilation ought to be of paramount importance; and judging from the opinions now discussed, and many more which might be quoted, the whole business is completely at sea, and the aspect of this important subject is that of a desperate evil as things are, and no sort of scientific remedy apparent to guide designers how they ought to go.

Every advocate of a ventilating system has his own special remedy for overcoming its acknowledged difficulty; nevertheless, however well these systems sound in theory, they generally fail, or may be only partly successful in practice; so the only hope remaining is to go to Nature and study her laws, so as thereby to gain a clearer knowledge how to accomplish that which natural laws succeed in doing when not interfered with by the blundering works of man.

The movements of large volumes of air for purposes of summer or winter ventilation may be carried out generally in three different ways, already noted :—

1. By vacuum (drawing air out of a room).
2. By plenum (forcing air into a room).
3. By a combined plenum and vacuum system.

Furthermore, admission of fresh air may take place—

(*a*). At the floor of a room.
(*b*). At, or near the top of a room.
(*c*). At intermediate levels.

Where special exits for foul air are provided, these may be situated at the top of a room for ascending currents, or at the floor of a room for the descending current system of ventilation.

The three systems of working with the six variations in admission or extraction of air give possibilities of great variety in the arrangements, which is very fortunate, as no hard or fast line can be maintained, for every position requires its own special consideration; and once the correct general principles are firmly rooted in people's minds, their application to suit every variety of condition is comparatively a simple matter.

Vacuum System.

This, the commonest system of ventilation, when applied to large halls, requires a powerful suction ventilator, generally fixed in the top of a room; and usually no provision whatever is made for an adequate supply of fresh air, consequently cold air is sucked underneath doors, flooding the floor with a layer of low temperature; also through cracks and crannies, causing high velocity draughts, which travel great distances, and produce any amount of discomfort and injury to health.

In ordinary dwelling-rooms the fire acts like the ventilator in drawing air out of dwelling rooms. As a rule, the first draught of importance is that under the doorway, while leaky windows contribute their quota, and an altogether surprising amount of air is drawn through the solid walls. In an ordinary livingroom, with a fireplace, an almost ideally perfect system of ventilation can be carried out by admitting fresh air in divided streams into the

*This statement serves as a curious commentary on a letter received by the present author from the Architects' Department of the London School Board, stating that "Considering the arrangements which are being made for ventilation in the schools of the Board, he (Lord Morpeth) does not consider it necessary to inspect the building named [namely the rooms n the Royal Botanic Society's Gardens, Figs. 4 and 5, mentioned in the author's letter], such building being one wherein he ventilation is as nearly as possible perfect!"

upper parts of such rooms, where it may mix with the warmer strata it finds there, and gradually descend and pass away eventually up the chimney.

Innumerable buildings and large assembly-rooms are ventilated on the pure vacuum system, and there is not a town of any moderate size in the kingdom which cannot furnish examples of this most barbarous arrangement. In London we have Exeter-hall, the School Board, and numerous schools; also St. James's-hall, which seems to excel all other places in the tremendous energy of its ventilating arrangements. Nearly all the theatres come in the same category. Then such places as the United Service Institution theatre excel in the perverse ingenuity which does not allow a single square yard of its area to be free from draughts; also such places as Prince's-hall, Piccadilly, the new "Empress" Rooms, and other places such as the meeting rooms used by the British Association in the several towns they visit, and hosts of assembly-rooms are deluged with cold air in this unscientific fashion. Sometimes, however, special inlets are provided for admission of fresh air in considerable volumes. When such inlets are made in the form of the well-known Tobin tube it is found that part of the air makes straight for the ventilator; while the remainder, having no velocity, tumbles in cold masses, by the action of gravity, upon the heads of the audience. Moreover, as there is no intimate mixture of the fresh supply with that already in the room, some parts of the room have their air unmoved, and left in a condition of complete stagnation.

Tobin Tube.

Fig. 1 represents a section, and Fig. 2 an elevation of a Tobin tube, at the Royal Institution, Albemarle-street. It is of the most modern design and proportions, and its vertical flat inlet tube measures 12 inches by 3 inches. Its total height, above the floor, is 5 feet 3 inches. The outlet is 20 inches wide at the back, and 18 inches at the front, with a 7 inch wide opening at the top; provided with a thin wire netting as cover.

Thus the sectional area for inlet .... = 36 sq. in.
And the sectional area for outlet .... = 133 " "

A current of air rising up the tube would have its velocity reduced in the proportion of $\frac{1}{3\cdot5}$ increased to $\frac{1}{4}$ by friction (approximately), when treated as a current of air. When a tube of this character is applied to a room filled with warm air, there would not b[e] sufficiently high velocity to cause it to ris[e] among a volume of air possessing great[er] heat, and less specific gravity, consequentl[y] cold douches would fall upon the heads [o]f those who happened to be sitting underneat[h]

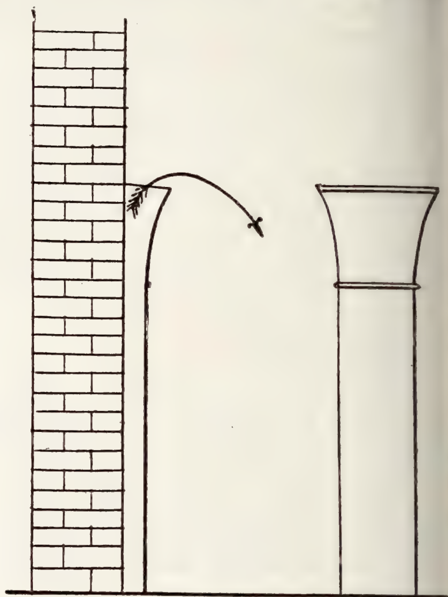

FIG. 1. FIG. 2.

or near to this inlet of fresh and cold air. Th[e] intention in this apparatus seems to be t[o] destroy most of the velocity which the curren[t] would otherwise possess on entering the room and it is not easy to see why such an objec[t] should have been put forward by the designer unless, perphaps, it was from a desire t[o] counteract some of the tendency of the ventilating arrangements in the roof to absorb al[l] the cold air coming from the Tobin tube before it could serve the intended purpose.

Society of Arts Ventilator.

Fig. 3 represents a section of the ventilating arrangements of the Society of Arts room, wherein we are now assembled. This system was designed by Mr. E. C. Robins, the architect, and it occupies all the north side, and about half of the eastern side. It consists of a kind of dado, placed 5 inches in front of the wall, and standing 10 feet high—on the north side, five inlets below, led up again outside, admit air trom the street, direct to the 5 inch space between the dado and the wall. Hot-water pipes are provided to warm the incoming air, quite independently of the hot-water pipes, which warm the air already in

room. The inlet openings are 10 feet ve the floor, covered with a somewhat close ing 6 inches wide, and along the whole thern) side of the room, and also along the ion of the eastern side, which latter is trated by Fig. 3. The grating for this ion measures 11 feet long by 6 inches wide,

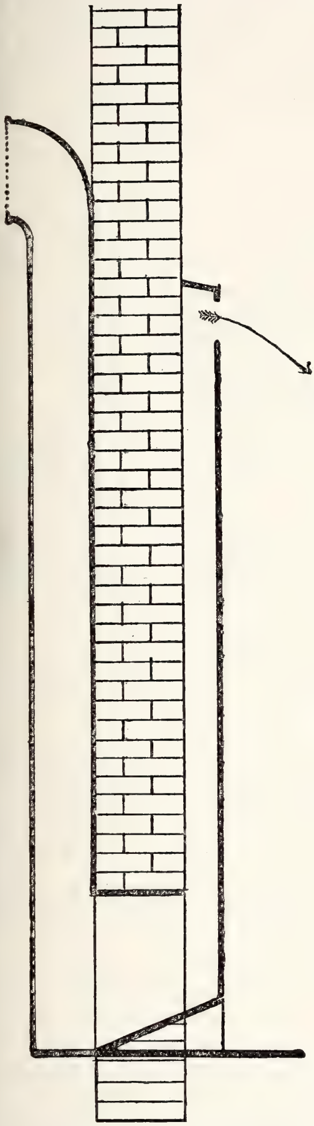

Fig. 3.

which area about one-half is closed by the ating bars. There is only one inlet grating ovided for this 11 feet long outlet, and it easures 24 inches by 12 inches, with a clear ea of about 200 square inches; inlet to room, ear area about 400 square inches: so the me object, rendering the velocity with which the air enters the room, seems to have been present in the mind of Mr. Robins, when he designed this arrangement. What with tortuous inlets, obstructive hot-water pipes, and other hindrances, the ratio between clear inlet and clear outlet must be greater than the proportion of 1 to 2. The air will fall as shown by the arrow on Fig. 3, and that it works so well is more due to the operations of the law of diffusion of gases than to the design itself. Indeed, it is this law which so often comes to the rescue of many badly-designed systems for ventilating.

The Plenum System.

By the plenum system, pure and simple, fresh air is forced into the room at any convenient locality, so no stagnant places need occur; and "foul" air finds its way out by open doors, windows, or leakages; in fact, through the very openings whereon advocates of the vacuum system rely for providing their supply of fresh air! The plenum system is independent of winds and weather; and indeed each system is essentially the opposite of the other.

Combined Plenum and Vacuum System.

By the combined operation of plenum and vacuum, considerable volumes of fresh air can be forced into a room, and a corresponding quantity can be extracted by a ventilator, situated generally on the roof.

But by whatever method a supply of fresh air enters a room, there are two grand divisions in which its disposal can be arranged—

1. As a general upward flow, from floor to ceillng, or roof, and out at the top.

2. As a general downward flow, from ceiling to floor, or roof to floor, and out at the floor.

There is nothing people cultivate more assiduously than the want of common sense, and the existing incomplete theories in regard to ventilation are generally due to confusion of ideas, assisted in no small measure by the persistent advocacy of various roof ventilators, or extractors, in connection with the too popular vacuum system. This advocacy is more remarkable for vigorous expression than for scientific truth, or academic impartiality. "It is clear," says one of these authorities, without giving reasons, "that the downward system can never supply really pure air to be breathed by the lungs; the exhalations of the human body are as they issue so warm that they must perforce rise," &c. Our "authority" very judiciously quits the subject of air breathed

in the lungs, for in spite of his clear conviction that it must perforce rise, everybody else knows perfectly well that our breath is driven *downward* by the natural direction of the nostrils, and there is no force causing it to ascend, unless, indeed, our instructor chose to stand on his head! As this line of argument might be inconvenient if carried on to its legitimate conclusion, it is promptly dropped, and we are invited to consider exhalations from the human body, which is quite a different subject.

It is differences in temperature, corresponding to differences in weights, that causes gravity to give movement to air all over the globe; and, so long as the air in an assembly-room is cold, it is easy to see that the breath will ascend if directed upwards, or descend when directed downwards. As the temperature of any assembly-room rises the differences become less, and the watery vapour condenses on windows and walls, or else sinks down, and would find its own exit were it not disturbed by strong currents of air due to the patent extractor on the roof, which is often quite strong enough to interfere with the action of natural laws.

Of course, we all know that trade circulars must not be taken too seriously, for they advocate a certain form of apparatus which may be all right under certain conditions, but which is unscientific and misleading when applied to every condition that may arise.

Human beings are designed so as to live a great part of their lives in buildings, or sheltered places, so the direction allotted to their expelled breath is *downwards*; but horses and other animals, intended always to live in the open air, and clothed accordingly, expel the breath from their nostrils sideways, as well as downwards. Both these arrangements are hints given by nature, which we should do well to consider, for they will not lead us astray, like an incomplete theory, and we learn that the simple law that hot air rises and cold air falls, must not be accepted without reservation. Indeed, it is this law, so stated, which in matters concerning ventilation, lies at the root of the thousand and one failures we see about us. Moreover, this theory cannot account for a single example of a room or hall ventilated without draughts, due mainly to an exhauster in the roof.

For what they may be worth, "authorities" of equal importance can be quoted in favour of upward ventilation or of downward ventilation; but in this, as in all other scientific questions, it is the eternal laws of nature that we have to study and ascertain, without any s deference to "authorities" who, after al only fallible human beings like ourselves.

While it is quite true that hot air asc because bulk for bulk it is lighter than air, it is also true that carbonic acid discharged from the lungs, is half as h again as air of corresponding tempera and the feeble force whereby air ma caused to ascend cannot prevail for against the heavier carbonic acid gas w falls to the ground while cooling, and obvi ought to be extracted there to rest nea earth, and feed the grasses of the field.

In regard to the ventilation of buildin is too often assumed that there is no h medium between that of breathing air ut foul and a system so profoundly scientific by no chance shall any part of the air that been once breathed enter the lungs.

The common-sense system mixes f air with that which has been breathed may be breathed again, and it does without draughts or appreciable inconvenie while the over-scientific system sends la volumes of cold or heated de-vitalised air the room, and expects the forceful, irreg currents to travel in all sorts of ingenious w that no independent currents would ever likely to follow under any natural impulse.

The most promising foundation system f proper and perfect ventilation is found in Tobin tube, or Mr. Hoey's arrangement, the plan now working at the Society of A But in all such examples, the minor det and general proportions are hopelessly wro The out-door inlet-gratings possess an a very much less than the outlets in the roo for the avowed purpose of reducing the d charge velocity into the room; consequent much of the fresh air (which is drawn in by suction of an exhauster in the roof) trav directly out through this exhauster; conferri but little benefit to the audience. Fortunate however, some scattered portions of air mix the laws of diffusion, while there are ot portions which tumble out of the wire grati or mouthpiece of the apparatus, thus causi those persistent draught for which the Tob tube and, in a less degree, the apparatus this room are famous.

Very little alteration would be necessary greatly improve this apparatus; indeed, almo to make it a pattern for copying elsewhere. the first place, a fan or other apparatus shou be added, so as to regulate the amount fresh air admitted, according to the seaso

l the audience. As mechanical power uld thus be available, the effects of conry winds might be neglected.

Of course, the existing exhaust ventilation, l all the openings in the roof, should be sed; as the system would be converted from acuum into a plenum system, and from an ward-flowing current into a downward-wing current, having for its inlet a narrow slit ng the entire north, and along 11 feet of the stern side of the room. Entering air might, en necessary, be warmed in winter, and oled in summer; and all vitiated air (*i.e.*, O_2 and water) would pass out through opengs below.

A suite of rooms, erected in 1898 at the cyal Botanic Society's Gardens, Regent's-ark, in London, has been provided with system of natural ventilation, which the uthor considers as nearly as possible perction, subject, however, to the one defect f being interfered with by contrary winds. his building runs almost due north and uth, and advantage has been taken of ie prevailing winds (which are south-west nd north-east) to apply the inlet arrangeients to *both* sides of the building, so that one or other can be relied upon. Of course, it would have been desirable to have a fan to make sure of a suitable current, but this could not be done, as no motive-power was available.

This suite of rooms consists of—

Entrance-hall.—21 ft. 6 in. by 17 ft. and 18 ft. high (not specially ventilated). Heated by two radiators, each 21 in. diameter by 3 ft. high. Lighted by three Welsbach gas incandescent burners.

Drawing-room.—22 ft. 6 in. by 26 ft. and 18 ft. high. Ventilated by three ventilators on west side only. Heated by one radiator on north side 4 ft. by 3 ft., one on east side 4 ft. by 3 ft., and one on west side 4 ft. by 2 ft. 5 in. Lighted by seven Welsbach incandescent gas burners.

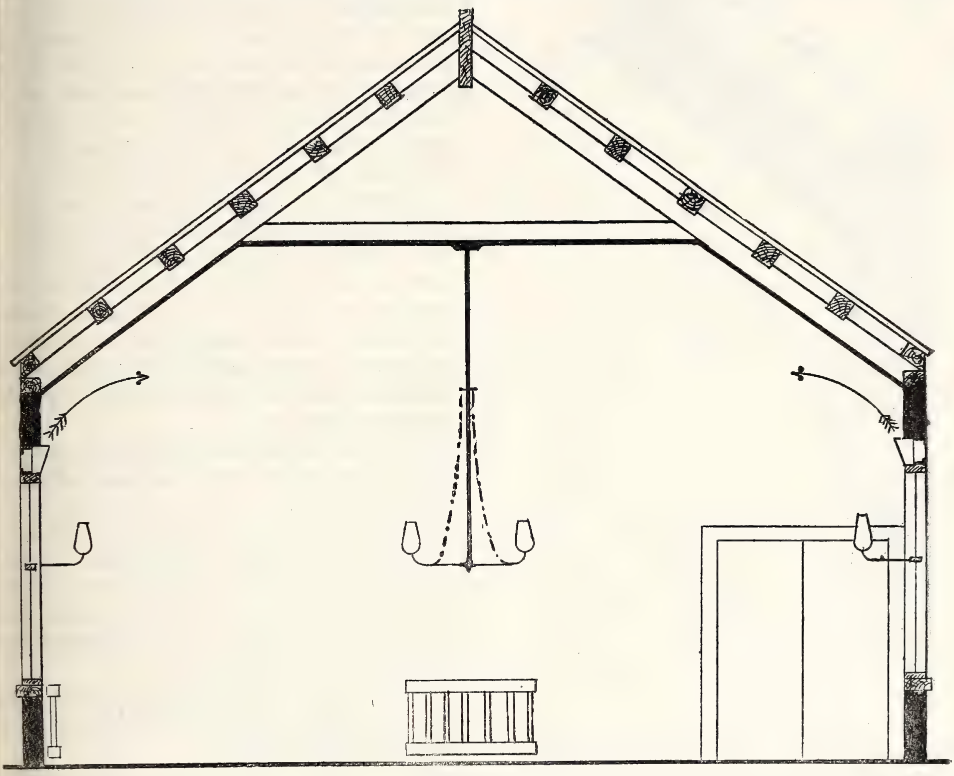

FIG. 4.

Library. — 22 ft. 6 in. by 17 ft. and 18 ft. high. Ventilated by two ventilators on west side only. Heated by one radiator on east side 4 ft. by 3 ft., and one on west side 4 ft. by 2 ft. 5 in. Lighted by two Welsbach incandescent gas burners.

Dining or Ball-room.—30 ft. by 45 ft. and 18 ft. high. Ventilated by ten ventilators, five in east and five in west sides. Heated by six radiators, each 4 ft. $7\frac{1}{2}$ in. long by 2 ft. 5 in.

wide. Lighted by twelve Welsbach incandescent gas burners.

Café.—30 ft. by 35 ft. and 18 ft. high. Ventilated by four ventilators, two on east and two on west side. Heated by two radiators, each 4 ft. by 2 ft. 5 in. Lighted by six ordinary gas burners.

A section of the dining or ball-room is given by Fig. 4, p. 193; and a section of one ventilator to a large scale is shown by Fig. 5. The room is

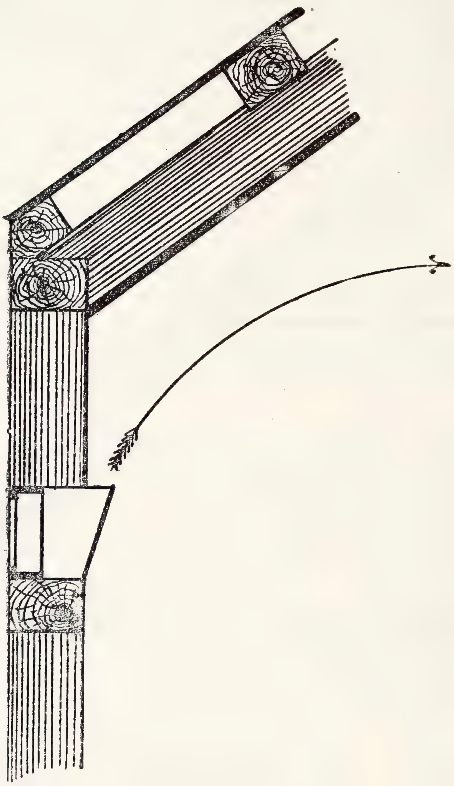

FIG 5.

18 feet high from floor to ceiling, and the roof is hermetically sealed, having no openings whatever. No special provision is made for the exit of CO_2 from below, as the doors and usual cracks and crannies are found to be sufficient.

The room is lighted by 12 Welsbach incandescent gas burners, so there is a considerable amount of heat to be disposed of. Fresh air is admitted by 10 inlets, five being on each side. These are set at about equal intervals apart along the room, and 2 feet below the springing of the roof, or ceiling. Each inlet grating is provided with a sliding shutter, whereby the area open can be regulated. Although the "air bricks" measure 11 inches by 16 inches outside, the clear area is but 30 square inches for each ventilator. T inlets to the room measure 16 in. × 3 in. 48 sq. in., or one-third of a square foot, a when tested by an anemometer the curre varied considerably, generally reaching a spe of 300 feet per minute, and sometimes t current reversed. The results of these arrang ments have been quite satisfactory, there is complete absence of draughts, and of tho cold douches of Arctic temperature which ma so many assembly-rooms in town or count models of discomfort and veritable death-trap Most of such rooms are decorated with a lavi generosity, while no care whatever is given ventilation, scientific or otherwise. Such roon are contentedly supplied with a big hot-a extractor in the roof, which creates all tl draughts below, and the whole barbaro arrangements takes a toll of human life whi it is perfectly appalling to contemplate.

It would be impossible within the limite time allotted to any one paper, to enter into a the aspects of efficient ventilation, for eac case must be separately considered. It more of an engineer's than an architect's wo to provide proper ventilating arrangement and several points may be expressed, in co clusion, giving the author's views upon th important subject.

1. Ventilation should, as far as possible, b carried out by the plenum, and not by th vacuum system.

2. Fresh air should be introduced as a upward current from openings above the head of an audience, but not so high as the ceiling It should be driven in divided streams into th upper part of the room, so as to mix with war air already travelling there.

3. Exits for carbonic acid, dust, and water vapour should be provided at or near to th floor level, if required.

4. The roof or ceiling of a properly-ventilate chamber should be hermetically closed.

5. Open windows should only be used durin warm weather, never in winter.

6. As natural draughts cannot always b relied upon, fans, or a furnace, or other mean of producing artificial draughts should b resorted to—when necessary.

Local convenience, surrounding buildings and sources ef pure air, are bound to requir many modifications in arrangements, and th general principles advocated in the presen paper are capable of an almost infinit variety in application. As the plans c scientific men like General Morin and Lor Kelvin have been distorted, and their purpos

llified by the blunders of those who should rry them out; great care is necessary, and ıch watchfulness to be sure that the plans properly carried out. This is all the more cessary regarding the views upheld in the esent paper, as they are quite opposed to pular ideas, and any blundering in their ing carried out would be gleefully set down popular prejudice as condemning the theory together, while the fault was all with the underers!

These popular ideas have had a prolonged ign, and have never in one single instance oduced any assembly-room properly venti-ted, while scores of failures can be placed to ieir account!

If the Commission on Tuberculosis succeeds spreading a knowledge of the value of esh air, and if the conclusions maintained in is paper show how such a supply can be btained without the risk of evils quite as reat, then one more blow will have been ruck against popular fallacies, and one more ictory gained for scientific truth.

DISCUSSION.

The CHAIRMAN said they had listened with great leasure to a most interesting, lucid, and admirable xposition of a very important question. Mr. Rigg ad thoroughly ventilated the subject; he had blown way some erroneous conceptions, and had introduced a breezy and delightful manner sounder modern rinciples. In hearing him they were not conscious f any of those cold douches of stifling confusion, or conflicting draughts which might have arisen had he ot been a master of the subject. Ventilation had a pecial interest imparted to it by the inauguration of he crusade against tuberculosis inaugurated at Marlborough-House under royal patronage about a ear ago, for of all the unhygienic conditions which conduced to the propagation of pulmonary consump-ion—the most deadly and widespread form of uberculosis—defective ventilation was undoubtedly he most important. Consumption abounded in arge towns, and was most common in the most densely populated parts of those towns where over-crowding and defective ventilation were at the maxi-mum, and the movement of pure air in and around he dwellings at a minimum. The most positive and convincing evidence on the subject was to be found in the history of life in barracks, prisons, schools, workhouses, asylums, and public institutions, where could be traced the most definite connection between defective ventilation and the prevalence of pulmonary consumption. Up to 1858, when the report of the Royal Commission on the sanitary state of the army was published, when the barracks were shamefully overcrowded, the phthisical mortality was excessively high; but immediately after steps were taken to increase the allowance of air per man, and when ventilation was to some extent taken in hand, the result was an enormous drop in the mortality from consumption; it fell from 11 to 3 per 1,000 per annum. Similar facts were observed with regard to prisons. The same thing occurred in proportion to the degree in which the male and female portion of the population were drawn into and engaged in indoor occupations. The pernicious effects of the exhalation of the chemical products of respiration, and the exhalations of the body; the products of imperfect combustion due to unscientific methods of lighting and heating were greatly intensified by the pressure of the tubercle bacillus, which was so widely diffused that it might be said to be present everywhere, entering the homes, probably the air passages of every one, and it was only to be combatted by fresh air. In close and confined places that bacillus had a terrible advantage, but when fresh air came in at the door, the tubercle bacillus flew out at the window. If Mr. Rigg could produce a system of domestic ventilation which would act as a sort of sanitary policeman, and keep the bacillus constantly moving on, he would incalculably aid the efforts now being put forward to prevent and cure consumption, and, finally, to abolish it altogether. He did not know whether he could suggest any method which would be applicable on a really large scale; but it appeared to him that ventilation was required not merely for dwelling and public buildings, but for the country at large. Owing to the ever-increasing population and industrial prosperity, dense clouds of smoke and foul vapours hung over vast tracts of country; rusticity was vanishing, and pure, unadulterated air was becoming exceedingly scarce. From the accurate experiments of Mr. Aikin, with which Mr. Rigg was no doubt familiar, it had been shown that while the air in the open country contained 2,000 particles of dust per cubic inch, the air in large towns contained 10,000,000 such particles, and air collected from gas-lighted and over-heated rooms as much as 30,000,000. Breathing air of that kind seemed almost like breathing pea soup. He was not competent to criticise technically the suggestions made, but from the physiological point of view he was rather inclined to favour a combination of the vacuum and the plenum system. The only absolutely perfect system of ventilation with which he was acquainted was that which was carried on in the lungs of an animal, into which fresh air was constantly introduced, and from which foul air was constantly expelled with unfailing regularity, smoothness, and effectiveness, suction and pressure being constantly and alternately at work. If Mr. Rigg could devise a system by which a house might be made to breathe gently—to inspire and to expire continuously, quietly, and almost imperceptibly, the beau ideal of ventilation would be attained. In the ventilation of the body by the lungs, there was a constant adjustment to constantly varying conditions

and circumstances. If the amount of foul matter in the atmosphere in the body increased, the lungs worked more vigorously; if there were free and oxygenated currents of air, the lungs worked more quietly, and it was that automatic action which he feared would be always beyond the power of any artificial system. The substitute for it, no doubt, was care, forethought, and attention, and in the case of public institutions and large buildings, that was available; but with regard to domestic dwellings, he feared it would be a broken reed to lean upon. Any system which involved the opening or closing of shutters, or the turning of handles or fans, would certainly be neglected by the unscientific handmaid, and would rather interfere with ventilation than promote it. The simpler and more automatic domestic ventilation could be made the better, and it was a strong recommendation in favour of the system Mr. Rigg advocated—that, when once established, it seemed on the whole tolerably automatic. He was rather surprised to hear one remark, which seemed in some degree to disparage the open window, which he regarded as an invaluable adjunct, and a ready means of compensating for weather changes and so on. On æsthetical grounds, he should decline to live in any room of which he could not throw open the casement to enjoy the view, whether of the stars, the sea, the fields, or even the passing omnibus; and whatever drawbacks there might be, the counterbalancing advantages were enormous. In the new system of treatment of tuberculosis now being adopted, it was a fundamental principle that all the patients should sleep with their bedroom windows open winter and summer. The open window was the starting point of the open-air treatment of consumption. It was the primary idea of the late Dr. McCormac, of Belfast, the pioneer of this movement, who pointed out the great risks of re-respired air, and the wholesomeness of absolutely pure air. In that connection, Dr. Moore, President of the Royal College of Physicians, Dublin, had narrated an interesting fact. He said Dr. McCormac insisted on the windows being kept open in his own house, and one winter morning going into the bedroom of his little boy to see whether the window was open, he found that it was, and there had been a heavy snowstorm in the night, the snow had blown in on to the floor, and even on to the bed where his little boy was sound asleep. That little boy was now Sir William McCormac, who was ministering to the wounded in South Africa. In conclusion, he must say that he felt some little jealousy at the comparison which had been made of the ventilation of the room in which they then were with that of the hall of the Royal Institution of Great Britain, with which he was connected. He occupied there a nice sheltered corner, and felt no draughts, but possibly they existed in other parts. Specimens of the air in the theatre had, however, been several times collected, and compared with specimens collected from all the theatres in London, and the air of the Royal Institution was incompara[bly] the best.

Mr. Graham Harris said the whole essenc[e of] the question lay in the remark of the Chairman, [that] "perfect ventilation should be absolutely imp[er]ceptible." He (Mr. Harris) had had to deal w[ith] ventilation from an engineering point in conn[ec]tion with many large buildings, such as luna[tic] asylums, and the difficulty might be illustrated by [the] old tale of the two ladies crossing the channel. O[ne] called upon the steward to open the port-hole or [she] would be stifled, while the other insisted that [it] should be closed or she would catch her death of co[ld]. At last an irascible old gentleman told the steward [to] open it until the one had been killed, and then [to] shut it and stifle the other, and then the rest [of] the passengers would be able to sleep in pea[ce]. What was suitable to one person or to one buildi[ng] was quite unsuitable to another. A room such [as] the one they were in, with no windows in the wal[ls], was comparatively easy to ventilate, but in a lar[ge] church or cathedral, the heat-retaining capacity [of] the glass was so much less than that of the wal[ls] that persons sitting under the windows felt a draugh[t], whilst those sitting very close to them, but again[st] the wall, were perfectly comfortable. Even in t[he] open air ventilation was not always perfect; in [a] north-east wind you had too much air, and on a h[ot] summer's evening not enough. Taking all thin[gs] into account, the task of the engineer in dealing wi[th] ventilation was by no means an easy one; he migh[t] add, however, that it had been made considerably easi[er] by the introduction of electricity in the place of ga[s], which added to the difficulty in many ways, as it bot[h] heated and vitiated the atmosphere.

Mr. O'Gorman said he should like to endors[e] Mr. Rigg's views as to the advantages of the plenum system, though the vacuum system might very usefull[y] be superadded. The first effect of the plenum syste[m] was to prevent any air entering at chinks and crannie[s] where it was not wanted; and if the air passed i[n] through a single aperture over which you had control you could treat it in any way you liked. You coul[d] purify it, not very readily by filtration, because of th[e] enormous power required to drive the air through th[e] fabric, but by passing it over a large surface of wate[r] you could stop practically all the particles of dust an[d] a good deal of smoke, which was the most difficul[t] impurity to get rid of. He had recently proved by experiment that air could not only be admitted at the bottom and sent upwards, but it could be forced down from the roof, which was important, because it was often difficult to get at the side walls to admit air, but you could always get at the ceiling of a large hall and make apertures. A simple arrangement of cones could be made, by which the current from one cone met those from the others, and shattered and diffused, and provided the velocity was properly proportioned to the sectional area of the

the air descended smoothly over the whole sur- By employing a coke filter, kept moistened, ad a large water surface, and could make sure ihilating the thickest London fog. If the air l through a 4 ft. aperture at the proper velocity st would be removed and retained outside. after this treatment a draught would be felt if were cold or if it were dry, as it then caused ration from the head and gave a cold sensation made the throat feel parched. Consequently it nperative to warm the air and to have some of spray arranged in the air path. Modern ating arrangements, therefore, were rather ate and must be so to be effective. To ventilate a room as that would probably require an of £800, at which people would be horrified, he attention of the audience depended on having the same facilities for breathing as if were on a moor. They wanted 3,000 cubic feet per hour each; and you could not obtain that ut a fan; and the conditions had to be adjusted ling to the number of people, the outside nstances, the hygrometric condition of the atmo- e, &c. He agreed with Mr. Harris that a single was easiest to ventilate. The best way of pre- g a lecture-room was to turn the air slowly over vater pipes into the room before the lecture, so warm the walls. Then, just before the lecture, at hot air should be rapidly removed, and fresh air introduced; the necessary warmth being ob- l from the walls by radiation. He had tried that od in the large picture gallery at Bridgewater- , and it proved perfectly satisfactory.

. OSWALD WHEELER suggested that Mr. Rigg not sufficiently emphasized the point, that ventilating in winter, a different treatment ne air—both before it got into the room after—was required, to what was necessary in ner. The difference of temperature caused a ence in the movement of the air. He could, personal experience, endorse what had been said [r. O'Gorman. To ventilate properly required e means, but it was no use to half do it.

. RIGG, in reply, said he quite agreed with the man as to the necessity for ventilation on a scale to get rid of smoke, but time did not of his going into that part of the subject. It quite true also that the combination of the m and the vacuum systems was very useful. The gements in every case had to be made to suit onditions. In the case he had referred to the m was, to some extent, automatic. The great ulty there was not so much with the ventilation ith the temperature. The people who danced it was too warm, whilst the chaperones those who did not dance said it was cold. Of course it was impossible to have temperatures in the same room; but neither complained of draughts. He agreed with the Chairman as to the advantage of an open window, speaking generally, but in a ball-room, in winter, where dancing was going on, it would be objectionable. He had not intended to say anything regarding the ventilation at the Royal Institution; but only meant to refer to a Tobin tube there, as one of the most recent designs of that apparatus. Mr. Harris had referred to the advantage of electric lighting, but in the case he had to deal with (Figs. 4 and 5), the rooms were lit by incandescent gas-burners; if in that respect there was more difficulty, on the other hand, there was an advantage in warming the room. He had known cases where, when electric lighting was introduced in a church, the heating apparatus had to be increased. Churches, of all places, were generally the worst ventilated. The filtering by means of water, as mentioned by Mr. O'Gorman, was a very good thing. The Americans carried it so far that they had perpendicular pipes with cold water running through them, on which the vapour settled and ran down into a trough below, and they also dried the air by passing it through water, strange as it might sound. In fact, the water took up the free particles of water in the air, and so it became dry. With regard to warming the walls, everyone knew that the radiation from a hot fire-place warmed the walls of a room, and they warmed the air; there was no heating of the air directly by the fire. For that reason, the hotter the fire the better the room was warmed with a comparatively small amount of coal. Of course, the arrangements in winter and summer must be different.

The CHAIRMAN then proposed a vote of thanks to Mr. Rigg, which was carried unanimously.

Miscellaneous.

ENGLISH COTTON TRADE.

It was the maritime adventurers of Elizabeth's days who first made this country commercially acquainted with the cotton fabrics of the East. In their semi-piratical voyages to the East, in competition with the Portuguese and Dutch, they secured supplies of cotton fabrics, calicos, muslins, prints, and dyed textures, which, when brought home, won the favour of those best able to purchase them, who paid good prices for them. Thus, on the one hand, a stimulus was given to maritime adventure in the East, and on the other, with the spreading favour accorded to these fabrics, a spirit of jealousy was aroused among the textile workers at home, who could not hope to rival the fairy-like productions of India. Thus the elements of a conflict were soon generated, and this developing, the most important consequences flowed therefrom. Strong efforts were made to crush out the new trade by legislative measures, heavy punishments being decreed by law against the importers and users of

them, and it was made a penal offence to bury the dead in any other fabric than one of wool. But the trade was only driven into subterranean channels: an extensive system of smuggling soon grew up, and the use of Indian fabrics continued to extend. The native artisans were foiled: there was nothing left to them but to contest the advance of the new favourites as best they could, and the outlook before them as far as they could see, was not bright. But, unawares to them, they were living in that dark hour which precedes the dawn, the dawn of a brighter day than has ever yet arisen except once before upon the earth. It was the dawn of the day of emancipation of all workers from the slavery of manual labour, which was accomplished by the revolution in our industrial system. This has transformed them in the course of a couple of centuries from manual to mechanical ones. About the time we have been speaking of, the great wizard of mechanics made his first appearance upon the scene, incarnated in the person of young John Kay, of Bury, in Lancashire, the son of a woollen manufacturer. Young Kay invented the fly-shuttle, which enabled one weaver to do the work it before required four to produce; while in the case of the wider fabrics, which needed two weavers to each loom, one weaver, with the new invention, could do the work of eight. This disturbed the whole of the industrial system; cotton wefts could not be obtained in sufficient abundance, and the weavers had to "play" more than half their time owing to their scarcity. The weaving trade waited for another inventor to redress the balance. He made his advent in the person of James Hargreaves, of Blackburn, who, in 1766 or thereabouts, invented the multiple-thread spinning-wheel, which afterwards became known as the "spinning jenny." This machine was the most wonderful ever seen up to that time in connection with the textile industries. It first spun eight threads at a time, which were soon increased to twenty. Still, these were only wefts: it could not make warp yarn strong enough. But the celebrated barber, who afterwards became Sir Richard Arkwright, came close upon Hargreaves's heels, with his spinning-machine based upon the different principle of the flax wheel. This would also spin a number of threads at a time, and, what was better, the yarn could be used for warps. It did not take long to discover this fact, and England could then make true calicoes. This soon resulted in a further rescue of the home market from Indian domination. Prints imitative of Indian designs had continued in favour, and these by the production of all-cotton fabrics, were greatly improved. Fabrics in the grey, and yarns as well, began to be exported, and Indian textile goods not only ceased to be imported, but in the early years of the present century were called upon to defend themselves from their erstwhile despised competitors. We have, however, pursued the subject far enough to bring out the contrast we desired between then and now.—*The Textile Mercury.*

OYSTER CULTURE IN FRANCE.

Artificial culture has for some time been l[…] depended upon in Europe and America for a s[…] of oysters. The chief breeding ground in Fra[…] the Bassin d'Arcachon, a triangular tidal bay […] nine miles on each side, entirely land-locke[…] opening out of the Bay of Biscay into the Depart[…] of the Gironde by a narrow channel about three […] in length. The coast is sandy and deserted. A […] forest of pines, planted during the present cen[…] has checked the inland march of the sand dunes […] protects the basin from the south-west winds […] blow fifty out of the fifty-two weeks of the […] According to the United States Consul at Bord[…] the shallow bay is networked with navigable chan[…] between which at low tide rise the half clay, half […] flats utilised for breeding the mollusc. During […] low spring tides the flats are covered with quan[…] of a cheap variety of ordinary roofing tile, which […] been previously coated with a sort of coarse w[…] wash. The spawn brought in by high water cat[…] on these tiles, and the lime of the whitewash l[…] the little mollusc to form his first shell. Tow[…] winter these tiles are taken up and carefully scra[…] The oysters, as large now as one's thumb nail, […] spread in flat-covered trays or baskets of clo[…] woven osier to protect them from the starfish, cr[…] and other enemies, and moved nearer the salt mar[…] on the east side of the basin to grow. When […] have become a little accustomed to an independ[…] existence, they are placed in trenches a little be[…] water level, which are provided with sluice gates […] which they can be flooded at will. They are […] prevented from being chilled in winter or dried u[…] summer, and are easily protected from enemies, […] gates being covered with wire netting of fine m[…] but the primary object of the gates is to accus[…] them to being deprived of water—that is, teach th[…] to keep their valves tightly closed when out of it. […] about 18 months their education in that respec[…] complete, and they are raked up, placed in barr[…] and sent on a journey of several days to Maren[…] and other places to fatten and assume the green […] and delicate flavour demanded by European epicu[…] About 250,000,000 are shipped annually. The w[…] on the beds is done by barefooted men and wom[…] both clad in bright crimson knee-breeches and ve[…] which render the sexes quite undistinguishable. T[…] regular trenches and dykes, kept in place with spi[…] interlaced with wattles, look like a Dutch garden.

SKIN WOOL IN GERMANY.

The German Credit Institute of Saxony has form[…] a Joint Stock Company, having for its object the p[…] duction of skin wool, which has hitherto been p[…] duced almost exclusively in the South of France a[…] Northern Italy. The United States Consul […] Glauchau says that glovers' wool has been produc[…]

[G]ermany in limited quantities. The textile in[dustr]ies were compelled to resort to France and Italy [to m]eet their requirements in this article. The term [skin] wool does not refer to a new sort of wool, but [appli]es to the raw products of animal wools hitherto [know]n as *Raufwoole* (scraped wool) or *Gerberwoole* [(tann]ers' wool). Under "wool" is collectively under[stoo]d the hairy covering of the various breeds of [shee]p, from which such wool is shown during life. [As,] however, the sheep can hardly be sheared down [to ab]solute nakedness, a certain amount of wool or [hair] is left as a covering after shearing. The product [so o]btained is known as glovers' wool. Now the [woo]l of slaughtered animals is mostly of inferior [qual]ity, and, moreover, materially shorter than that [obta]ined by shearing the live animals, for which [reas]on the former is used for making up inferior [text]iles, such as low class flannels, &c. Skin [woo]l is wool which is scraped off the skins of [dea]d sheep. The wool obtained in this manner is, [as a] rule, longer, stouter, more healthy and uniform [tha]n that obtained by shearing, because sheepskins [are] mostly obtained from animals slaughtered for [foo]d, which must necessarily be sound, large, and [hea]lthy, whereas shorn wool is obtained, as well, [fro]m sickly, decrepid animals—such as are found in [eve]ry flock. Skin wool is consequently likely to be [mo]re uniform in respect of fineness of quality, because [in s]craping the wool off the skin, the coarser portions [wh]ich grow on certain parts of the body can be [sor]ted more carefully than is the case with shorn [flee]ce. Skin wool and glovers' wool are thoroughly [diff]erent in character. The latter is principally re[mo]ved from the skin by chemical means, and, in con[seq]uence, has not the same value as the shorn wool [for] the wool industries, more especially where it is a [qu]estion of producing sensitive colours. Skin wool [on] the other hand, is obtained without using chemi[cal]s, and is fully equal to shorn wool in respect to [qu]ality, and indeed for certain purposes—*i.e.*, as abb [wo]ol (warp)—it is often preferred to shorn wool, [ow]ing to its tenacity and length. Where skin wool [is] desired, the main thing is to allow the fleece to [ha]ve had a growth of from eight to twelve months. [A]s to the process of producing such skin wool, and [its] commercial value, nothing has yet been made [pu]blic in Germany.

General Notes.

[S]IBERIAN FORESTS.—The Russian Ministry of [A]griculture has assigned the sum of 50,000 roubles [to] be expended in the forests in the Governments [of] Tobolsk and Omsk, in accordance with the [m]ethods usually practised in the arrangement of [fo]rests in European Russia. The object in view is [to] prevent the increasing destruction of Siberian [fo]rests.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

JANUARY 24.—"Local Government and its relation to Parish Water Supply and Sewerage." By W. O. E. MEADE-KING, M.Inst.C.E. SIR BENJAMIN BAKER, K.C.M.G., will preside.

JANUARY 31.—"The Undeveloped Resources of the Bolivian Andes." By SIR MARTIN CONWAY, M.A. MAJOR LEONARD DARWIN will preside.

FEBRUARY 7.—"Housing of the Poor." By EDMUND WILSON.

FEBRUARY 14.—"The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD.

FEBRUARY 21.—"Artistic Copyright." By EDWIN BALE. Sir L. ALMA TADEMA, R.A., will preside.

FEBRUARY 28.—"The Electrical Induction Motor on Mountain Railways." By PROFESSOR CHARLES A. CARUS-WILSON, M.A.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S.

Dates to be hereafter announced:—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Orloff Process of Colour Printing." By W. H. WARD.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

FEBRUARY 8.—"New Projects of Railway Communication with India." By JAMES MACKENZIE MACLEAN, M.P.

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

[The meetings of February 8, and May 17 will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

Tuesday or Thursday afternoons at 4.30 o'clock:—

[The reading of Sir Charles Dilke's paper on "The Century in our Colonies," announced for February 1st, is unavoidably postponed.]

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

MARCH 20 (Tuesday).—"Imperial Telegraphic Communication." By SIR EDWARD A. SASSOON, Bart., M.P.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

JANUARY 30.—"Niello Work." By CYRIL DAVENPORT. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

[Mr. John Sparkes's paper on "The Best Means of Arresting the Decay of Indian Art," announced for reading on February 13, is unavoidably postponed.]

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

APRIL 3.—"Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

MAY 8.—

MAY 29.—

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

BENNETT H. BROUGH, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

LECTURE I.—JANUARY 22.

Deposits in which ores of the useful metals are met with—Beds, veins and masses—Classification of ore deposits—Methods of mining formerly employed—Recent improvements.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bennett H. Brough, "The Nature and Yield of Metalliferous Deposits." (Lecture I.)

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. J. S. Curwen, "The Traditional Songs of the Iroquois Indians."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Mr. B. Champneys, "The John Rylands Memorial Library, Manchester."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. J. H. Knight, "A Year-and-a-Half's Experience with a Benz Motor Car.".

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. F. York Powell, "The Future of History."

TUESDAY, JAN. 23...Royal Institution, Albemarle-street, W., 3 p.m. Prof. Ray Lankester, "The Structure and Classification of Fishes." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W p.m. Mr. J. A. Sauer, "Swing-bridges over River Weaver at Northwich."

Photographic, 66, Russell-square, W.C., 8 Major-Gen. J. Waterhouse, "Note on Dr. Vog Method of Preparing Subholoid Salts of Silver.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. A. Smith-Woodward, "Notes on some Remain *Grypotherium (Neomylodon) listai* and associ Mammals, from a Cavern near Consuelo C Last Hope Inlet, Patagonia." 2. Mr. C. V. Peel and others, "A Collection of Insects Arachnids made in 1895 and 1897 in Somali-la with Descriptions of New Species." 3. Mr. E. de Winton, "The Mammals obtaine Southern Abyssinia by Lord Lovat during Expedition from Berbera to the Blue Nile."

Japan Society, 8½ p.m. Conversazione at the Ro Institute of Painters in Water Colours, Piccadi W.

WEDNESDAY, JAN. 24...SOCIETY OF ARTS, John-str Adelphi, W.C., 8 p.m. Mr. W. O. E. Mea King, "Local Government and its relation Parish Water Supply and Sewerage."

Geological, Burlington-house, W., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p. Mr. J. Castle-Evans, "Natural Forces—Lig Heat, &c.

Royal Society of Literature, 20, Hanover-squa W., 1 p.m.

THURSDAY, JAN. 25.. Royal, Burlington-house, W., 4½ p.m

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p. Mr. Alfred Rhodes, "Early Days of Beethoven.

Society for the Encouragement of Fine Arts, Conduit-street, W., 8 p.m. Mr. G. Langl "Music as a Means of Expression."

Royal Institution, Albemarle-street, W., 3 p. Dr. W. H. R. Rivers, "The Senses of Primiti Man." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W 8 p.m. 1. Adjourned discussion on the "Repo of the Institution's Visit to Switzerland." 2. M Sherard Cowper-Coles, "An Electrolytic Centr fugal Process for the Production of Copp Tubes."

Camera Club, Charing-cross-road, W.C. 8½ p. Captain Hinde, "The Masai."

FRIDAY, JAN. 26...Royal Institution, Albemarle-street, W 8 p.m. Weekly Meeting. 9 p.m. The Hon. (H. Parsons, "High-speed Navigation — Stea Turbines."

Civil Engineers, 25, Great George-street, S.W., p.m. (Students' Meeting.) Mr. C. B. Fo "The Simplon Tunnel."

Mechanical Engineers, Storey's-gate, St. James's park, S.W., 7½ p.m. Mr. William Schönheyde "Water Meters of the Present day; with speci reference to small flows and waste in dribbles."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington house, 5 p.m. 1. Prof. Ayrton and Mr. Mathe "Some Developments in the use of Price's Guar Wire in Insulation Tests." 2. Dr. E. Barton an Mr. L. Lownds, "Reflection and Transmission o Electric Waves along Wires." 3. Mr. T. J Barker, "The Frequency of the Transverse Vibra tions of a Stretched India-rubber Cord."

SATURDAY, JAN. 27...Botanic, Inner Circle, Regent's-park N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m Sir Hubert Parry, "Neglected Byways in Music." (Lecture II.)

..ournal of the Society of Arts,

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FRIDAY, JANUARY 26, 1900.

..*communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.*

Notices.

CANTOR LECTURES.

..On Monday evening, 22nd inst., Mr. ..NNETT H. BROUGH delivered the first ..ture of his course on "The Nature and ..eld of Metalliferous Deposits."

..The lectures will be printed in the *Journal* ..ring the summer recess.

INDIAN SECTION.

..Thursday, January 18, 1900; LORD JAMES .. HEREFORD in the chair. The paper read ..s on "Our Work in India during the Nine..nth Century," by Sir WILLIAM LEE-..ARNER, K.C.S.I.

..The paper with report of discussion will be ..nted in next week's *Journal.*

..Proceedings of the Society.

..EIGHTH ORDINARY MEETING.

..Wednesday, Jan. 24, 1900; SIR BENJAMIN ..KER, K.C.M.G., in the chair.

..The following candidates were proposed for ..ction as members of the Society:—

..derson, Archibald, 30, Oxford-square, W.
..ver, Prof. Frederick William, M.A., 62, Lancaster-..oad, Notting-hill, W.
..ncock, Fred, Campbell-place Works, and Lower ..Wolfe-street Pottery, Stoke-on-Trent.
..es, John Arthur, Gijon, Asturias, Spain.
..wrence, Mervyn, 1, St. Leonard's-studios, St. ..Leonard's-terrace, Chelsea, S.W.
..llins, Lieut.-General John, Heatherwood, Mid..urst.
..ny, Arthur Paul, Primrose Club, Park-place, St. ..ames's, S.W.
..uelson, Godfrey Blundell, 7, Cadogan-gardens, ..W.
..nell, Alfred, 15, Upper Belgrave-road, Clifton, ..ristol.

The following candidate was elected a member of the Society:—

Bates, Samuel Bakewell, Mingin, Chindwin, Upper Burma.

The paper read was—

LOCAL GOVERNMENT AND ITS RELATION TO PARISH WATER SUPPLY AND SEWERAGE.

By W. O. E. MEADE-KING, M.INST.C.E.

It will doubtless be allowed without comment that two of the most important duties of a local authority are to provide for the inhabitants under their jurisdiction (1) a proper, wholesome, and adequate water supply, and (2) a proper and efficient means of disposing of the sewage of their district. The questions of water supply and sewerage, when dealing with the sanitary conditions of a parish, are so closely allied, it is impossible to deal with one without the other, and more often than not the possession of a plentiful supply of water, properly laid on, is the precursor, as it ought to be, of a scheme for the disposal of the sewage. Assuming that the first duties of a local authority are as stated in the opening paragraph, the question arises, do these authorities in the rural districts of England carry out the duties for which they are responsible in a proper and efficient manner?

Perhaps it would be putting it too strongly to say the answer must be in the negative, as due allowance must be made for the many difficulties that present themselves, but certainly the information gained as the result of much investigation seems to point in the direction of a negative answer.

It is an astonishing fact that most schemes introduced by authorities to deal with either the water supply or sewerage of a parish meet with opposition from the persons to be benefited thereby, and whether it is the fear of this opposition, and possible loss of the position of notoriety enjoyed when the next election takes place, or whether it is owing to a want of knowledge as to the requirements of the locality to be dealt with it is impossible to say, but the fact remains that a large majority of schemes are launched, in the first place, in a manner to lead one to suppose it was the intention to do as little as possible, and to shelve the remainder for those who come after to undertake, regardless of what the consequences may be to those living at the present time.

Under the Public Health Act, 1875, anyone

who thinks he has sufficient grounds to do so, can complain to the Local Government Board that the authority responsible for such matters in the district in which he resides or has property has made default in providing that district with sufficient sewers, or that the water supply is insufficient or unwholesome.

On receipt of such a complaint a public inquiry is generally held at the place in question. Whether it transpires, after such inquiry, that any further action can be taken in the matter or not, a most extraordinary state of things generally presents itself; the following two instances may perhaps be of interest as showing the state in which some communities live and, at the same time, the unwillingness evinced to make matters any better.

In one case I had to inquire into an alleged improper water supply, and found, on investigation, the parish was entirely dependent on ponds of surface water, situated some in fields, some in private gardens, and some by the roadside, open to cattle, pigs, and even worse forms of pollution, and yet, because the inhabitants had dipped their water from the ponds from time immemorial, they had great objection to going to any expense in order to remedy such a state of things.

In another case an alleged insufficiency of sewers and pollution of a stream was the subject of complaint made; the authority freely admitted it, and the argument used by them in defence was "we have drained into the stream in question for the best part of a century, and therefore claim a prescriptive right to do so," and this, regardless of the various Acts passed for the suppression of this evil, during the last thirty or forty years.

Persons making complaint as to an alleged improper water supply have to produce evidence to show that works to remedy the evil can be carried out at a reasonable cost, which naturally opens a very wide question, for so far as the author is aware, no one has ever laid down any rule or principle yet on which a reasonable cost could be based.

It has been argued that if it can be shown a scheme can be carried out for a sum not exceeding one year's assessable value of the district it should be looked upon as reasonable.

The following figures concerning 20 places which have come under the writer's immediate observation may be worthy of note, and may be of some assistance in deciding this point. The 20 places in question had an average population of 2,460, and an average annual assessable value of £9,320. The avera estimated cost of scheme per place came £1,917, or about 15s. 7d. per head of t average population.

In only one instance of all the 20 did t estimated cost of the scheme exceed one yea assessable value, in only three instances did come near one year's assessable value, and all the other cases it was very considerab below, seldom reaching one-half.

Small places have been purposely pick out, as obviously it would be unfair to inclu large towns, going a long distance for the water. Nevertheless, in cases of water suppl the circumstances, in nearly every case, diff so materially that it would not be safe assume that anything over 15s. 7d. per he would be unreasonable, and, moreover, scheme for the supply of a population of two three hundred would be more expensive pr portionately than one for two or three thousan inhabitants.

Should the complaint be one concernin sewage, or rather the want of sewerage, t necessity to prove that a scheme can be carri out at a reasonable cost, according to t wording of the Act, does not exist. Neverth less, it is interesting to note the amount which the average estimated cost of sewag schemes works out, and the following figur show that in most cases such a scheme nee not cost anything like one year's assessab value.

Fifty places have been taken which hav come under the writer's immediate observatio during the last three or four years. Of thes places the population varies from over 27,00 in one case, to about 500 in another, the ave age being about 4,300.

The average annual assessable value of th same 50 places comes to £19,850, varying fro about £81,000 in one case, to about £1,500 i another.

The total estimated cost of sewerage an sewage-disposal schemes came to £228,18 or an average estimated cost per place c £4,551, or rather less than a quarter of th average annual assessable value.

The actual average estimated cost of schem per head of population works out to £1 1s. 10d Since analysing the above figures, the write has become indebted to Messrs. Hinnell an Murphy, Civil Engineers, of Manchester an Bolton, for a description of the Bolton Sewag Purification Works, as lately carried out b them, and after giving the actual cost of inter cepting sewers, sewage works, and land, ther

urs the following sentence:—"It will be served that this amount is at the rate of out £1 per head of population." So that, parently, even in cases of large towns, these culations would sometimes hold good, but course instances must necessarily occur in tain localities where such calculations would upset, and if some, owing to their surround-s, proved more expensive, others situated the coast, and draining into tidal waters, ght save the expense of artificial or land atment, and would, therefore, expect to get cheme carried out for something less than average.

t is not proposed in this paper to touch on the question of the advisability of ces, large towns in particular, draining o tidal water without previous purification at any rate, partial purification of the vage, beyond saying that, in the author's nion, the correctness of such a method sewage disposal is exceedingly doubtful. w if these 50 places, scattered as they are r nearly every county in England, can be en as any guide, it comes to this, that a ce having a population of, say, 4,300, and annual assessable value of, say, £19,850, uld expect to have to borrow about £4,700 carry out a scheme of sewerage and sewage posal. This they could probably do at out 3 per cent., and the repayment of capital l interest spread over a term of about 30 rs, would require an annual outlay for that e of about £240, which would be met by her less than a 3d. rate. This, or even ible this sum, could hardly be looked upon a heavy tax, in view of the great advantages ned.

To return to the question of water supply, very common reason given at inquiries, opposition to the scheme, by the in-bitants of the place to be benefited, is Ve have dipped what water we want from h and such ponds," or "We have used the ls in the village for the last 50 years, and death-rate of the parish shows it to be a ticularly healthy one, and we do not want change, or any such unnecessary expense urred."

Now, in the first place, in all probability the l water supply was the indirect means of ing off the weakly and sickly infants long , and the present population represents the vival of the fittest, and, in the second place, s believed the average healthy man or nan, especially in country districts, can get limatised to what would ordinarily be considered a very foul water supply, without any immediate ill effects, but the chances are that such a supply affects the constitution, rendering it liable to attacks of disease, and in the event of an epidemic breaking out in the country, a place with a bad water supply stands the risk of being first attacked, and, consequently of being the first to spread disease.

Poverty, though often pleaded as a reason why no scheme should be carried out, is very rightly considered as no excuse, and it is hoped to show in this paper that good sanitary conditions in a parish have, as a rule, an opposite effect on the riches of a parish to that generally supposed by the inhabitants.

From researches made it would appear that the rateable value of parishes throughout the country is rather on the decrease than otherwise, though it is gratifying to find that those having good sanitary conditions form a large majority of those which can show an increase in rateable value.

There are, at the present time, 7,936 parish councils in England, to say nothing of the numberless parishes not possessing that luxury, therefore it will be readily understood that in making inquiries concerning water supply and sewerage, it was necessary to limit the field to some extent. Accordingly, 200 parishes were selected at random, the writer having no previous knowledge of them. No parish was chosen having a population of less than 1,000, or more than 1,500, and, for the purpose of making the information general, a few were taken from every county in England, exclusive of London county.

The counties chosen numbered 41, which perhaps needs a little explanation; in some instances a county is possessed of more than one County Council, such as Yorkshire, Suffolk, and others, and sometimes these have been called two counties and sometimes one, but it is sufficient to say that, as the term county is generally understood, every county in England is represented.

Of the 200 parishes selected, 76 show an increase in rateable value during the four years 1894-1898, 109 show a decrease, and in 15 cases the returns of rateable value could not be obtained.

The total rateable value of these 185 parishes in 1894 was £1,450,848, and in 1898 £1,432,029, showing a decrease in the four years of £18,819. It is believed from observations made whilst professionally engaged in every part of the country, that the results of inquiries made

concerning the 200 parishes chosen will convey, with very fair accuracy, the state of all parishes throughout the country.

It now remains to be seen what the sanitary conditions are under which these 200 parishes exist. It is not intended to attempt to prove that good sanitary conditions necessarily cause the rateable value of a parish to increase, but if they do not it is very evident from the following figures that the disastrous results anticipated by opponents to sanitary measures are seldom realised, and that such measures at any rate have the appearance of improving the financial status of the parish.

Out of the 76 parishes that can show an increase in their rateable value during the four years, 1894-1898, 20 obtain their water entirely from waterworks, while out of the 109 showing a decrease of wealth in the same period, only 12 obtain their water entirely from waterworks.

Of those giving no returns as to rateable value five obtain their water in this way, thus showing that out of these 200 parishes 37 are dependent entirely on waterworks for their water supply and that a substantial majority of them can show an increase in their rateable value. Looked at in another light the above figures show that 26 per cent. of the parishes obtaining their water from waterworks can show an increase in their rateable value, whilst only 11 per cent. of the parishes on a similar footing show a decrease. The advantages of a good and plentitul water supply laid on in a district are so manifold and obvious, it is not intended here to enter into the merits of such a supply.

Some parishes combine waterworks and wells for their water supply, that is to say, water is laid on to the main part of a village, whilst isolated houses and farms, &c., are dependent on their own private wells; this is doubtless the next best form of supply to that from waterworks only, and out of the total number of 32 parishes so situated, no less than 23 show an increase in their rateable value, out of the 76, or 30 per cent., and only seven out of the 109 parishes, or about 6 per cent., show a decrease. In two cases the rateable values could not be obtained.

As has already been stated it is not intended to attempt to prove that a good and regular water supply, or any other good sanitary condition, necessarily sends up the rateable value of a parish, and this is shown by the figures given in the two cases already quoted, in each of which some parishes show a decrease, but it is thought to be as well t emphasise the fact that in the first case, th: is, where the supply is from waterwork only, and, in the second, where it is fro waterworks and some wells, only 11 p cent. and 6 per cent. respectively show decrease in rateable value, as against 26 p cent. and 30 per cent. that can show a increase.

A parish may be situated on the outskirts a town, when its rateable value is almost certai to increase, but in such a case a parish almost equally certain to have a good wat supply, and to be properly sewered.

On the other hand, a parish may decrease i riches from a number of causes on which n amount of sanitary measures would or coul have any effect.

It may be urged in some localities, not to favoured in water-bearing strata, that it quite beyond their means to go the distanc they would have to in order to secure a advantageous site for waterworks. In suc places the Derwent scheme, before Parliame in Session 1898-1899, forms a good precede and example of what can be done by c operation.

But whatever the expense surely it must admitted, at this the close of the 19th centur that in theory at least, every place, be it ev so small, should have wholesome water broug in pipes, beyond risk of contamination, a that no place, certainly where any populati is grouped together, should be dependent shallow wells. Out of the 200 parish selected, as will be readily understood, by f the larger number are dependent entirely shallow wells, this being the common form village water supply throughout the countr The day is bound to come when every shall well will have to be closed. The followi figures showing the rate of increase in pop lation, are sufficient to prove this:—

Population of England in 1750, estimated at	6,400,0
Population of England in 1801, estimated at	8,892,5
Fifty years later, in 1851, it was doubled.	16,921,8
The census of 1881 showed it to be	24,613,9
Whilst the census of 1891 showed it to be	27,501,3

If a shallow well was a safe source of supp in 1800 or even 1851 the chances are it will n be so in 1900, the population now being mo than three times what it was in 1800.

It is gratifying in a way to find that of t parishes dependent entirely on wells, of whi there are 101 out of 200, only 23 out of the

30 per cent., show an increase in rateable lue, while out of the total number of 109 iich show a decrease 71 parishes, or 65 per nt., thus get their water. Seven parishes pendent on wells give no returns of rateable lue.

It does not seem right at such a time in ondon's history there should ever be any fear a water famine, yet a summer never passes thout this fear finding vent in the leading ticles of London's daily papers. Nevertheless ondon has a certain supply at its doors and ater can be obtained in every house by the nple process of turning a tap, and those who vell there are apt to forget the country parishner dependent on a doubtful water supply.

During the hot dry summer of 1899 many stricts dependent on shallow wells were aced in great difficulties, not to say danger, e water level falling in many instances lower an ever hitherto known, and in some cases sappearing altogether; as a result of this e writer has seen it stated that many outeaks of typhoid and diphtheria have been rerted, the worst outbreaks having occurred here the drinking water has been most arce. The dangers of such a water supply, en when water is plentiful, are too many to umerate, but to show the callousness that ists, the writer has found more than once in untry districts a pump and well on which rhaps three or four cottages at least would dependent, the well being about 20 feet ep in gravelly soil, whilst immediately above e well the village churchyard was situated, so in gravelly soil. In the same way that aterworks, and waterworks and wells are comned, so it is in the case of wells, and wells d rainwater and ponds, &c. Referring again the list of 200 parishes—24 obtain their ater from a combination of wells and rainater collected, and ponds, &c., but out of the showing an increase in their rateable value, ly 3 parishes, or about 4 per cent., thus get eir water, and 20 parishes, or about 18 per nt. out of the 109 showing a decrease, are pendent on this as the source of their supply. ne parish in this category gives no returns as rateable value.

As might be supposed, the parishes dendent entirely on rainwater or ponds are few d far between; out of the 200 chosen, there e only two, one of which shows an increase the rateable value, and one a decrease; and, ewise, those dependent partly on rainwater d partly on waterworks are few—there is ly one, and that one shows an increase in rateable value. Little or nothing could be said against rainwater for a supply if there was enough of it, and if sufficient care was takeu in collecting and storing it; but, unfortunately, it generally means a water-butt placed on the ground by the side of the house, which receives every first washing from the roof, and any excess of rain on the roof after the first washing, which would be the cleaner water, probably runs to waste, owing to the incapacity of the butt to contain more.

Before leaving the subject of water supply, taken independently of sewage, there yet remains one other form of supply, namely, parishes dependent on rainwater, wells, and waterworks; of these, there are two showing an increase in rateable value, this being equal to 2·6 per cent., and one a decrease, being equal to ·91 per cent., the fact of waterworks forming even a part of the supply appearing in this, as in other cases, to have something to do with, if not to actually insure, an increase in the rateable value.

It now remains to be seen what effect, if any, sewage and sewage disposal, irrespective of water supply, has on the rateable value of a parish

It is astonishing to find how few people there are who trouble themselves about the disposal of the sewage either of their district or their house, provided the sewage is taken away somewhere or somehow, and that they suffer no inconvenience. Therefore sewerage, as might be expected, does not show the same marked effect on the well-being of a parish as a good water supply apparently does, but nevertheless the odds are still in favour of those parishes properly drained.

Of the 200 parishes previously alluded to, 37 are sewered and treat their sewage at disposal works. Of these 3 give no returns as to rateable value, leaving 34 parishes which can be considered, and it is found that 21 parishes, or about 27½ per cent., show an increase, and only 13 parishes, or nearly 12 per cent., show a decrease in the rateable value.

It is satisfactory to find that those parishes which have gone to the expense of sewering, but go no further, and are offenders under the Rivers Pollution Prevention and other Acts, on account of discharging their sewers direct into a stream, should apparently suffer. Only 31 out of the 200 parishes dealt with do so, and one of these gives no returns as to rateable value. Of those left, 10 parishes, or about 13 per cent., show an increase, and 20 parishes, or 18 per cent., a decrease in their value.

It would probably astonish people, did they but know it, what a number of parishes there are scattered throughout the country that are without any system of sewerage; these can for present purposes be divided into three classes:—

1. Parishes not sewered, but causing pollution of a stream or streams by private drains.

2. Parishes draining by private drains into cesspits, but not causing pollution of a stream.

3. Parishes draining into cesspits, and by those overflowing, or by other means, causing pollution of a stream.

In the first mentioned class, namely, parishes not sewered, but causing pollution of a stream or streams by private drains, 19 show an increase in rateable value out of the 76 so doing, being equivalent to 25 per cent., and 21 show a decrease out of the 109 in that predicament, being equal to about 19 per cent., and this seems to point to the truth of the remark that people do not seem to care what becomes of their sewage provided it is got rid of.

As to the second class, parishes draining by private drains into cesspits, but which do not cause pollution of a stream, 27 parishes out of 76, or about 35 per cent., have increased, and 45 parishes out of 109, or about 41 per cent., have decreased in their value.

Though cesspits are open to many objections, and should not be encouraged, certainly where the water supply is derived from shallow wells, this no doubt is satisfactory so far as it goes, inasmuch as in these cases no streams are polluted.

There remains the third class, parishes draining into cesspits, but by their overflow, &c., causing pollution of a stream. This last is about the worst form of getting rid of the sewage of a parish, and it is disappointing to find the honours so nearly divided as regards the rateable value.

Out of the total 200 parishes, 48 appear to be content to exist in this state, and of these 17, or about 22 per cent., have increased, and 26 parishes out of 109, or nearly 24 per cent., have decreased in rateable value between the years 1894-1898.

Having now dealt with water supply and sewerage independently, it still remains to be seen what effect the two combined have on parishes. Out of the whole number of 200 parishes selected, only 23 both get their water from waterworks and are sewered to disposal works, but of this number no less than 15 out of 76, or over 19 per cent., have increased in rateable value, while only six out of 109, or abo 5½ per cent., have decreased.

Of parishes obtaining their water from wate works, but which are not sewered and draine to cesspits or streams, there are 25 out of tl 200, and of those in which it is possible compare the rateable values, 16 out of 76, 21 per cent., have increased, and 6 out of 10 or about 5½ per cent., have decreased in valu showing once more that, given a good wat supply, the public care little what becomes the sewage so long as it disappears.

As is well known, and as has been shown i this paper, the majority of parishes are d pendent on wells of greater or less depth f their water supply, but some parishes d pendent on this source are properly sewere and the sewage treated at disposal works.

In such cases the source of the water supp may very possibly be all that can be desire provided, of course, none of the wells are liab to contamination by the sewage disposal are or other polluting source.

Only 21 parishes out of the total 200 are such a state, but 12 out of 76, or nearly 16 p cent., show an increase, while only 8 out of 10 or about 7 per cent., show a decrease in the value, a margin which, once more, is greatl in favour of good sanitary conditions.

The parishes having the worst sanitar conditions, so far as water supply an sewerage are concerned, are those depende on shallow wells for the former, and, at th same time, are polluting streams and ditche and making use of cesspits.

Unhappily, these form the great majorit no less than 135 parishes out of 200 living i this condition, but it is some consolation find that only 39 out of 76, or 51 per cent., ca show an increase in rateable value, while 8 out of 109, or 80 per cent., show a decrease the balance (8 parishes) give no returns as rateable value. The danger of such a conditio of things are too obvious for comment.

Before leaving the subject of the analysis parishes, as regards their sanitary state an rateable value, mention must be made of or county alone where information regarding th source of water supply and means of disposin of the sewage was obtained from no less tha 67 parishes, and the result of this informatio goes to prove, first of all, the serious state things that prevail, and, secondly, that goo sanitary conditions enrich rather than im poverish the community.

Of these 67 parishes, it was found that 5 (including one that is dependent on rain wat

[so]me extent) are dependent entirely on [shall]ow wells for their water supply, and 53 out [of th]ese 58 have no proper system of sewer[age,] but turn their sewage into ditches and [strea]ms, thereby offending under the various [Acts] passed for the suppression of this evil, to [say n]othing of endangering their water supply. [In ad]dition five use cesspits.

[Se]eing what is done with the sewerage, it is [smal]l wonder to learn that in the majority of [case]s the wells, on analysis, are pronounced [to be] suspicious and in many cases dangerous [and] unfit for use.

[Ou]t of the total number of 67 parishes re[ferre]d to, 42 give the returns of population at [the l]ast census (which varies from about 2,500 [to 5]0) also the rateable value in 1894 and [1898].

[It] has been found that 22 parishes out of [thes]e 42 have increased in rateable value during [thes]e years, while the remaining 20 have de[crea]sed, the balance showing a total increase [in ra]teable value of £9,071.

[It] is interesting to note that out of the 22 [pari]shes that can show an increase in their [weal]th, eight obtain their water from water[work]s, and seven are sewered and treat their [sewa]ge at disposal works, and out of these 15, [six] both get their water from waterworks and [are] sewered, the sewage being dealt with at [disp]osal works, while out of the 20 parishes [that] show a decrease in their value, only one [gets] its water from waterworks, and none have [sewa]ge disposal works, and the one getting its [wate]r from waterworks has only decreased to [the e]xtent of £4 in its rateable value.

[If] further proof be needed of the advantages [gain]ed, from a pecuniary point of view, by a [good] water supply and sewerage system, it [may] be as well to quote a still more remark[able] instance which occurs in another county, [wher]e the complete returns are available for 44 [per] cent. of all the parishes in the county [havi]ng Parish Councils. Out of this number [only] one parish can show an increase in its [ratea]ble value in the four years 1894-1898, and [this] is the only parish obtaining its water [from] waterworks, sewered, and treating its [sewa]ge at disposal works.

[Al]l the others obtain their water from wells, [and,] with one exception, where the parish treats its sewage at disposal works, all run their [sewa]ge by private drains direct into streams [and] watercourses, and, in one instance, cess[pits] are in use as well. Double this number of [paris]hes in this same county give returns as to [their] water supply and sewerage, but no returns as to population and rateable value. With the exception of the one instance mentioned above, none of them derive their water from waterworks, nor are any of them sewered, and they all pollute streams by means of private drains.

Such, then, is the general state of parishes throughout the country, and yet it is said nothing is more characteristic of the close of the 19th century than the extent to which sanitary science has come to the fore.

It may have been said, and no doubt has, but it cannot be correctly said, so far as country parishes are concerned, that the desire for good sanitary conditions is much greater now than it was before the days of any legislation on the subject.

So long as agriculture remains the staple industry of the country, the future prosperity must in a large measure rest with the parishes, the general tendency of which is not to increase materially in population.

Of course, there are exceptions, where some previously unforeseen event suddenly causes a parish to increase by leaps and bounds, but, as a rule, the general inclination of the rising generation is to seek commercial employment in some large business centre, rather than to follow the usual line of business to be found in an agricultural district, hence the outcry throughout the country as to the scarcity of agricultural labour.

By carrying out proper works of water supply and sewerage, not only would labour be employed in the parish, for the time being, but the general health and well - being of the parish would be increased. The fact, also, of the sanitary arrangements being good would be an inducement to people to live there rather than to seek the close confines of a large business centre; these people, it is true, would very likely occupy better-class houses, but if so, such houses not only bring up the rateable value of the parish, but also necessitate the employment of labour.

So-called agricultural improvements in the way of drainage, are doubtless responsible for the complaint, now so often heard, that there is not as much water in the country as there used to be. The rainwater which, in former days, used to percolate quietly through the ground and keep the rivers and streams full for days and weeks together, now gets away into the nearest watercourse in as many hours and is gone; but is this not all the more reason why steps should be taken without loss of time to secure all the water that it is possible

to get, and to keep its consumption under proper control, and its source free from all chance of pollution.

If the parishes produce children weakly by reason of insanitary conditions, both the towns receiving the rising generation and the parishes themselves, and therefore the country at large, must necessarily suffer. It is hoped the information gathered together in this paper will be sufficient to satisfy local authorities and the public generally that money laid out on works of water supply and sewerage not only ensures health, but wealth.

DISCUSSION.

Sir ALEXANDER BINNIE said it was somewhat foreign to his experience to deal with small communities such as were referred to in this paper, but still he had seen many cases such as those alluded to. He was not in a position to confirm that most interesting part of the paper which went to show that the wealth as well as the health of a community was increased by proper sanitary appliances as he had not the necessary data. Undoubtedly there were large numbers of people in small communities scattered about of 2,000 or 3,000, who were living in a very hazardous state, and there were many instances where the health of the inhabitants was endangered by the pollution of the water supply through sewage matter. It often occurred that in such cases the people said they had been for many years drinking water which they declared to be perfectly wholesome—though science showed that, if not absolutely harmful, it was at least suspicious—and therefore they might go on for the future as they had done. On that point he bowed to the authority of Sir George Buchanan, who pointed out conclusively that communities—sometimes large ones—might go on drinking water which was highly polluted without apparent harm, but sooner or later a time came when that water took upon itself morbific qualities, and there was an outbreak of disease in some form or another which led to epidemics of a serious nature. He always looked on these small supplies with great suspicion, not that the people were unhealthy, but they were living under circumstances which might at any moment become exceedingly unhealthy. His advice was to ascertain very carefully if the source of supply was in any way contaminated, and if it was to inspect it, and either let the water alone or boil it. That might be managed in small communities, but in large ones would be too expensive. With regard to the drainage of small communities, and the possible contamination of neighbouring streams, of late years the system of intermittent filtration had been adopted very largely, and this went a long way to render the effluent comparatively safe, if not completely so. expense of such a system on a moderate scale was large, though of course it became onerous if ap to hundreds of thousands or, possibly, million people. They might hope that as sanitary science more impressed on the people, the day would c when there would be a direct money return fo outlay on drainage works in the shape of incre rateable value; it was probable that would be He suggested that the figures Mr. Meade-King collected would be even more valuable and interes if they were presented in the form of a table diagram.

Sir JAMES CLARK, Bart., suggested that in s cases the increase of rateable value which author had attributed, partly at least to the be system of drainage and water supply, must due to those parishes being near to large to or cities where they had greater facilities getting a water supply than parishes purely the country. Nothing had been said about dry earth system of sewage disposal, which many advantages in some cases, though there w also difficulties. One was that you were so depen on individual effort for its being properly carried and in large houses there were inconveniences. in small parishes like one with which he was c nected (Pangbourne), where any system of w carried drainage would be very difficult and expens it was perhaps the soundest system and probably cheapest. Dr. Vivian Poore had carried on many periments in this direction, and his experience was t it could not only be rendered effectual, but a dist source of revenue. He suggested that all the so should be separated from the fluid portion of excreta, which could easily be arranged, and that solids, instead of being buried at a consider depth, should be put on the ground wit covering of a few inches of earth only; he found that in three months or less their prese could not be detected. The ground could then sown with cabbages or coarse feed and afterw used in the ordinary way. If the inhabitants villages and cottages were brought up to treat sew matter in this way they would not only get rid c nuisance, but would benefit by getting well manu soil for their gardens which was not in the l offensive. Dr. Poore himself had the refuse of sc 29 cottages, when treated in this way, placed on garden of rather less than an acre, without slightest offence, and the production was gre increased.

Dr. SEATON agreed with the previous spea that if a parish were situated on the outskirts c town its rateable value was almost certain to crease. The paper was very interesting and encour ing, but he could not altogether follow Mr. Mea King in what he said about sewerage schemes be comparatively inexpensive. Experience in the cour

London was rather different; and although al officers were entirely agreed that there l be efficient sewage works in all places of ɔ and upwards, still when you came to scattered s and cottages the problem was difficult. There eemed to get the maximum of cost, and also of vantage. He remembered Sir Robert Rawlinson g in that hall many years ago that sewerage nes were never likely to cost more than £3 per ; but in some villages he feared it would come ree or four times that amount. The cost of a ne was one thing when put before the Local rnment Board, and sometimes a very different when it came to be carried out. It seemed an ialy to have a sewer a mile long, with only all cluster of cottages draining into it. It was times very difficult to prove that the health of people was improved by sewerage schemes. hoid, diphtheria, and those diseases which they learned to associate with sanitary conditions, times prevailed as much in unsewered districts as did in sewered. Where sanitary works were ed out, the district would be more attractive to ents, and the majority of people having lived in is were accustomed to modern appliances, and 1 they went into the country they liked to have same conditions. Though he had not spoken enthusiastically in favour of sewerage schemes, must admit that where there were no such mes, there were always disagreeable nuisances h arose because the local authorities hardly , in the country, dealt efficiently with the tion of scavenging. If this were more oughly attended to, there would be less need of nsive systems of sewerage. With regard to the earth system, he should like to see it thoroughly ed out in some village, but he was afraid a really l example of it was not to be found. Dr. Vivian re had taken great pains with it at Andover, and aged to get his tenants to carry out his instruc- s thoroughly, and there he could testify from ervation it was very satisfactory; but the real blem was how it would work under ordinary litions. In conclusion, although a good water bly was absolutely essential to the health of a rict, he did not think it necessarily followed that mall scattered communities sewerage schemes were riably the most desirable solution of the sewage culty. It was a treat to hear a paper which dealt 1 this subject in such a practicable and straight- vard manner, without going into engineering nicalities.

Ir. BLACKALL SIMONDS said he took it as a eful sign that sanitary authorities in rural districts e more alive than formerly to the importance of question. He did not see the necessary connec- 1 between the rise in rateable value of a parish the sanitary condition and water supply; other s would operate concurrently. Such improve- its were demanded by a large influx of population, which also caused a rise in the value. On the other hand, where parishes were decreasing in rateable value, there would be the opposite state of things. There would be agricultural depression, a diminution of population, and houses falling into decay. In all cases in which the District Councils took the pains to ascertain, through the sanitary inspectors and officers of health, where zymotic diseases prevailed traceable to insanitary arrangements or a filthy water supply, they did their best to remedy the defects. Villages differed immensely in character. In some there were a large number of houses close together in a street, and these no doubt must be treated by some common system of sewerage, but it would be impossible to apply the same system to scattered parishes, such as the one in which he lived. The cost of carrying a sewer to a single house would, in many cases, be more than the value of the house itself. Such places could only be treated by some such system as Dr. Poore described; but it would only be practicable if carried out in a systematic way, the contents of the pails being dug into the gardens. Then the water supply, even from shallow wells, must he fairly satisfactory. Where you had a cesspool within 10 ft. of a local water supply, you could not help having the water contaminated. He believed that in these matters the sanitary authorities were now taking pains to remedy defects, by calling on the owners to close certain wells and provide others, and forbidding the use of cesspools in close proximity to houses. In time, with better education, they would find even the peasant population more alive to the risks they ran by slovenly habits.

The CHAIRMAN, in proposing a vote of thanks to Mr. Meade-King, said the paper must have involved a great amount of labour and calculation, but the results would be very valuable, and he had no doubt it would be carefully studied in print by the members of the Society, especially those living in the country.

The vote of thanks having been carried unanimously,

Mr. MEADE-KING, in reply, said he had purposely picked out a parish with a population of from 1,000 to 1,500 in order to limit the field a little. Sir Alexander Binnie had referred to people drinking polluted water for a length of time without suffering from it, and he knew such was the case, but a medical officer of health had given him the history of a group of six cottages which were supplied with most unwholesome water, yet he never could trace any illness in anyone in those cottages. After a certain time the occupants of one cottage left, and within six weeks of new tenants coming in there were three cases of typhoid, showing that it was the intermittent supply that did the harm, but that people might get acclimatised to almost

anything. He would consider Sir A. Binnie's suggestion, and try to arrange the figures in form of a table or diagram. With regard to the parishes dealt with they were not as a rule adjacent to large towns, but he could not give the situation as he had undertaken not to disclose their names or whereabouts. With regard to the dry earth system he should like to know what the water supply of Pangbourne was; if it was from shallow wells he should have some misgivings as to possible danger during the three months that the refuse lay on the ground. He thought a certain amount of percolation must take place through the ground. It was quite true that sewage schemes sometimes cost more than the estimates, but that could not occur without the knowledge of the Local Government Board, because the local authorities would have to come for a further loan. The schemes he had mentioned were, however, he believed, completed for the sums he had named. In scattered communities a great deal might be done by co-operation. He had a case recently in which five parishes combined for a water supply, and the total cost came to one-third of the annual assessable value. It might be, of course, that other causes contributed to the rise in value, but the fact remained that in the large majority of cases, it coincided with an improved water supply and good sanitary conditions. No one would propose that isolated cottages should be included in a big sewage scheme; some other means must be adopted in such cases.

Miscellaneous.

THE WORLD'S GOLD PRODUCTION.

Notwithstanding the stoppage of gold supplies from South Africa in the closing months of last year, *The Economist* reports that there was a considerable increase in the output of the precious metal. No complete details are yet available, but several of the large producers obtained augmented quantities of the precious metal during the twelve months. In the United States, for example, according to the estimate of the *Engineering and Mining Journal* of New York, the production of gold in 1899 amounted to nearly £14,500,000, showing an increase of close upon £1,500,000. From Canada the increase is estimated at £870,000; from Australasia the expansion in the output amounted to about £3,250,000, and from India to about £100,000. On the other hand, the available supplies from South Africa were reduced to the extent of about £1,500,000, so that on balance there would appear to have been from these five among the leading producers an increase of something like £4,220,000. There were smaller increases from some other directions, and allowing, roughly, £1,000,000 for these, we arrive at a total expansion of about £5,200,000 for the year. According to the final estimate of the director of the United States Mint, the wor production of gold in 1898 amounted to £57,500,c and if the increase just mentioned is added, have an aggregate of £62,700,000 for last ye which compares with previous estimates of the sa authority as follows:—

Year.	Value. £	Year.	Value. £
1899	.. 62,700,000	1894	.. 36,200,00
1898	.. 57,500,000	1893	.. 31,500,00
1897	.. 47,000,000	1892	.. 29,300,00
1896	.. 40,600,000	1891	.. 26,100,00
1895	.. 39,900,000	1890	.. 23,800,00

In six years, therefore, the production of gold rather more than doubled, while as compared w the first year of the decade, the increase has excee 160 per cent. The present outlook is, of course good deal clouded by the uncertainty regarding duration of the war in South Africa; but, apart fr that, there is every reason to assume that producti will continue to expand at a rapid rate.

Correspondence.

VENTILATION WITHOUT DRAUGHTS

I have read with some astonishment the paper Mr. Arthur Rigg, printed in the last *Journal of t Society of Arts*, and I feel that many misleadi theories and statements therein should not go u challenged. The object of the paper seems to be decry the vacuum system of ventilation, Mr. Ri speaking of this "barbarous arrangement," and forth. Again, in favouring the plenum system, says that "the foul air finds its way out by op doors, windows, or leakages, in fact through the ve openings whereon advocates of the vacuum syste rely for providing their supply of fresh air."

Is he not aware that, with a properly-designed e traction installation, the pure fresh air is admitt through suitable openings and warmed on its wa As Mr. Rigg rightly mentions the importance ventilation in connection with the treatment of p monary diseases, I would instance the arrangeme at the Royal National Hospital for Consumption Ventnor as a large and successful example of t vacuum system, which has been at work there for so years. In this case, an air-tight subway, about 6 square in cross section and about 400 yards lo connects with some 300 rooms in the eleven bloc and with the chapel by means of branch air ducts various sizes, fitted where they join the subway w slides regulated from above. The foul air is exhaust from this subway by a large fan, delivering abo 20,000 cubic feet of air per minute, day and night, a shaft 70 feet high, being at the rate of 5,000 cu feet per head per hour. A boiler supplying steam the fan-engine also provides steam at a reduced pr sure for heating the blocks, the radiators being p

controlled, and placed so that the incoming air is suitably warmed. So much for Mr. Rigg's ures on the vacuum system.

must also controvert his theories as to the ion of the foul air outlets in a room. His idea CO_2 sinks is a fallacy in practice. It does so in l jar in the laboratory, but in a room it is subject ie upward motion of heated air, and to the nts induced by ventilation. His illustration of in beings expelling breath downwards from the ils is worthless, as can be proved by observing becomes of the smoke exhaled by a smoker igh his nose. Undoubtedly, the concurrence of ical opinion is rightly in favour of foul air outlets ess than 7 or 8 feet above the floor level.

gain, as to open windows, Mr. Rigg's advice is etrically opposed to that of the National ciation for the Prevention of Consumption, recommend in their Leaflet No. 3, of 1899, :—"Windows should be made to open to the nal air, and should be kept open day and night, s this is forbidden by the medical adviser."

stly, I would say that no one system (plenum, im, or anything else) is suitable for all and every of building. It must be left to the competent ieer, with an open mind, to decide on such ers, and to settle all details, after making a careudy of the requirements of each particular case.

F. C. NUNN,
Assoc.M.Inst.C.E., Mem.San.Inst.

Obituary.

OF. D. E. HUGHES, F.R.S.—Mr. David Edward hes, the distinguished electrician, who was a life ber of the Society of Arts, died on Monday, 22nd He was born in London, May 16th, 1833, but arly life was spent in the United States. Before as of age his musical attainments procured him osition of Professor of Music in the College of stown, Kentucky, and not long afterwards he me Professor of Natural Philosophy at the same ge. In 1855 he patented his famous typeing telegraph instrument. On April 13th, 1859, H. Hyde read a paper before the Society of Arts Professor Hughes's System of Type-Printing graph and Methods of Insulation, with special ence to Submarine Cables." At this meeting, (afterwards Sir) William Fothergill Cooke was in hair, and Professor Hughes was present, and made further explanations in the discussion (see *Journal*, VII., p. 334). In 1878, Prof. Hughes communito the Royal Society his researches on the microe, which may be said to form the foundation of nodern telephone in all its power and sensitive- Another of his electrical contrivances was the tion balance, respecting which Sir W. Robertsen read a paper at the Sheffield meeting of the British Association, 1879. Prof. Hughes was President of the Institution of Electrical Engineers in 1886. In 1880 he was elected a Fellow of the Royal Society, and was awarded the Royal Medal in 1885 In 1897 he was presented with the Albert Medal ot the Society of Arts, by H.R.H. the Prince of Wales, President. The terms of this award, were in "recognition of the services he has rendered to Arts, Manufactures, and Commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone." Prof. Hughes was a frequent attendant at the meetings of the Society.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock :—

JANUARY 31.—"The Undeveloped Resources of the Bolivian Andes." By SIR MARTIN CONWAY, M.A. MAJOR LEONARD DARWIN will preside.

FEBRUARY 7.—"Housing of the Poor." By EDMUND WILSON.

FEBRUARY 14. — "The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD.

FEBRUARY 21. — "Artistic Copyright." By EDWIN BALE. Sir L. ALMA TADEMA, R.A., will preside.

FEBRUARY 28.—"The Electrical Induction Motor on Mountain Railways." By PROFESSOR CHARLES A. CARUS-WILSON, M.A.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S.

Dates to be hereafter announced :—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Orloff Process of Colour Printing." By W. H. WARD.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock :—

FEBRUARY 8.—"New Projects of Railway Communication with India." By JAMES MACKENZIE MACLEAN, M.P.

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

[The meetings of February 8, and May 17 will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

Tuesday or Thursday afternoons at 4.30 o'clock :—

[The reading of Sir Charles Dilke's paper on "The Century in our Colonies," announced for February 1st, is unavoidably postponed.]

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

MARCH 20 (Tuesday).—"Imperial Telegraphic Communication." By SIR EDWARD A. SASSOON, Bart., M.P.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock :—

JANUARY 30.—"Niello Work." By CYRIL DAVENPORT. SIR GEORGE BIRDWOOD, M.D., K.C.I.E., C.S.I., will preside.

[Mr. John Sparkes's paper on "The Best Means of Arresting the Decay of Indian Art," announced for reading on February 13, is unavoidably postponed.]

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

APRIL 3.—"Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

CANTOR LECTURES.

Monday evenings at 8 o'clock :—

BENNETT H. BROUGH, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

LECTURE II.—JANUARY 29.

Sources of the world's supply of gold and silver—Principal mines now worked—Future resources.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bennett H. Brough, "The Nature and Yield of Metalliferous Deposits." (Lecture II.)

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. C. A. Duff Miller, "St. John, New Brunswick, as a Canadian Winter Port."

Surveyors, 12, Great George-street, S.W., 8 p.m. Adjourned discussion on paper by Mr. John Nisbet, "Forest Management, with Suggestions for the Economic Treatment of Woodlands in the British Isles."

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Dr. E. F. Willoughby, "Elementary Statistics."

Actuaries, Staples-inn Hall, Holborn, 5½ p.m.

Camera Club, Charing-cross-road, W.C. 8½ p.m. Rev. C. H. Grundy, "Social Effects of the Bicycle on the New Man, New Woman, and New Child."

London Institution, Finsbury-circus, E.C., 5 Mr. Walter Crane, "The Elements of Linear pression."

TUESDAY, JAN. 30...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. (Applied Art Sect Mr. Cyril Davenport, "Niello Work."

Royal Institution, Albemarle-street, W., 3 Prof. E. Ray Lankester, "The Structure Classification of Fishes." (Lecture III.)

Civil Engineers, 25, Great George-street, S.W p.m. Mr. R. Runeberg, "Steamers for W Navigation and Ice Breaking."

Anthropological, 3, Hanover-square, W., 8½ p.m

WEDNESDAY, JAN. 31...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. Sir Martin Con "The Undeveloped Resources of the Boli Andes."

Sanitary Institute, 74A, Margaret-street, W., 8 Mr. J. Castele-Evans, "Water—Pollution Purification."

Archæological Association, 32, Sackville-street, 8 p.m.

Patent Agents, 19, Southampton-buildings, W 7½ p.m. 1. (*a*) Discussion on Mr. Newton's pa "Hints for the Development of the Chart Institute of Patent Agents." (*b*) The Preside Opening Address. 2. Mr. J. Imray, "Subj matter of a Patent."

British Astronomical, Sion College, Victo embankment, E.C., 5 p.m.

THURSDAY, FEB. 1.. Royal, Burlington-house, W., 4½ p.m

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr B. Clarke, "Botanic Nomenclature." 2. Prof Ray Lankester, "The Zoological Results of Expedition to Mount Roraima in British Gui undertaken by Messrs. F. V. McConnell and J Quelch."

Chemical, Burlington-house, W., 8 p.m. 1. Me W. J. Sell and F. W. Dootson, "The Chlo Derivatives of Pyridine." (Part V.) "Synth of $\alpha\alpha'$-Dichloropyridine; constitution of C zinic Acid." 2. Messrs. S. Ruhemann and H Stapleton, "The Formation of Heterocyclic C pounds." 3. Messrs. W. J. Pope and S Peachey, "The Space Configuration of Qua valent Sulphur Derivatives—Methyl-Ethyl-Thе Dextrocamphorsulphonate and Dextrobromoc phorsulphonate." 4. Mr. M. O. Forster, "Ni camphane."

London Institution, Finsbury-circus, E.C., 6 p Mr. J. D. McClure, "Shooting Stars."

Royal Institution, Albemarle-street, W., 3 p Dr. W. H. R. Rivers, "The Senses of Primi Man." (Lecture III.)

Camera Club, Charing-cross-road, W.C., 8½ p Mr. C. E. Phillips, "The Discharge of Electri through Gases."

FRIDAY, FEB. 2... Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting. 9 p.m. Signor Marc "Wireless Telegraphy."

Sanitary Inst., 74A, Margaret-street, W., 8 p Mr. J. Castell-Evans, "Air and Ventilation."

Geologists' Association, University College, W 7½ p.m. Annual Meeting. President's addres "The Natural History of Phosphatic Deposits

Junior Engineers, Westminster Palace-h S.W., 8 p.m. Mr. E. W. Porter, "Bridges Piers."

Quekett Microscopical Club, 20, Hanover-squ W., 8 p.m.

SATURDAY, FEB. 3...Royal Institution, Albemarle-street, 3 p.m. Sir Hubert Parry, "Neglected Byway Music." (Lecture III.)

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FRIDAY, FEBRUARY 2, 1900.

communications for the Society should be addressed to he Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

Ir. Bennett H. Brough delivered the ond lecture of his course on "The Nature Yield of Metalliferous Deposits," on nday evening, Jan. 29, his special subject ıg the sources of the world's supply of gold silver.

he lectures will be printed in the *Journal* ing the summer recess.

APPLIED ART SECTION.

uesday, January 30th, 1900; Sir George dwood, K.C.I.E., C.S.I., in the chair.

he paper read was on "Niello Work. By ril Davenport.

he paper with report of discussion will be ıted in the next number of the *Journal*.

Proceedings of the Society.

INDIAN SECTION.

Thursday, Jan. 18, 1900; the Right Hon. rd James of Hereford in the chair.

The paper read was—

R WORK IN INDIA IN THE NINETEENTH CENTURY.

By Sir William Lee-Warner, K.C.S.I., M.A.

am profoundly conscious of the difficulties ich must surround any one who attempts to ıl, in the short period of one hour, with a ject of so wide and general a scope as that igned to me by the Society of Arts for this ning's discussion. I believe that the terials for history, collected and published he last hundred years, exceed all that had r been written about India in all previous ıturies, whether before or after the Christian era, and I shall briefly support that belief. There have been three Indias known to history: the Buddhist, dating from B.C. 259, when Asoka, the royal convert to Buddhism, held sway from Afghanistan to Mysore, and from Kathiawar to Orissa; the Mohammedan, dating from 1001 A.D., in which year Mahmud, son of Sabuk-Tigin, first invaded the country; and the British, which I venture to date from A.D. 1757. Before B.C. 315, a landmark in Indian history which we owe to the research of Sir William Jones, who identified Chandragapta, founder of the Maurya dynasty, with Sandrokoptus, to whose court Megasthenes was sent as the ambassador of Seleucus, king of Syria, nothing certain is known of India. The Vedas, the Codes of Menu, and the miscellaneous collections, known as the Ramayana and Mahabharata, shed a very hazy and distorted light upon ancient India, for they are smothered with mythology and legends, and convey no idea whatever of its political history. Matters are not much improved in the Buddhist era, despite the debt which we are taught that we owe to classic writers, such as Megasthenes, Strabo, Arrian and Pliny, or to Chinese travellers, such as Fa-hien, who reached Benares in A.D. 405. Coins, inscriptions, faded paintings on the walls of caves, and other material relics in stone, earth, or clay, bring messages from past ages, and convey to us a few impressions about the people, but without history or literature they yield to us a very incomplete picture of life in India in olden days. The tragedy of vanished empire may, indeed, be laid bare by a single stroke of a navvy's shovel as he cuts a railway embankment, but without literary works we must remain in the dark as to the secrets of its rise and fall. I know that it is considered heresy to speak lightly of Megasthenes and Arrian, and only lately I read a patriotic paper which quoted their testimony to show the high standard of happiness and civilisation to which India attained both before and after the commencement of the Christian era. But when I take down the small volumes from my shelves and read in their pages the tales of the river Silas in which nothing can float, of the men who could not be brought to Sandrokoptus "because their heels are in front and the toes turned backwards," of barking men with heads of dogs, of hoary-haired babies, of races which sleep on one ear and cover their bodies with the other, of men without mouths who live on perfumes, and of ants which dig for gold, I find myself inclined to discount other state-

ments, such as that famine was unknown in India, or that "no Indian ever did, or suffered, wrong, and, therefore, they made no contracts and required no security." I feel that these high-famed historians of olden days have got hold of stories from the Mahabharata, and I accept the criticism of Arrian that you may trust the writers who accompanied Alexander when they describe India as far as the Hyphasis, but "beyond that limit we have no real knowledge of the country" (Arrian's "Indika" 6).

After the first arrival of Mahmud we reach more solid ground, and the history of India begins to be written by contemporary historians. But the tide of Afghan invasions which flowed into the country with Mahmud, deluged Nagarkot, Kanuj, and Somnath with blood, and when once more it ebbed, in 1738, sucking back from Delhi Nadir Shah, "the boast, the terror, and the execration of his country," the marble palaces of Akbar and the noble tombs of the Emperors of Mohammedan India looked down upon streams of blood flowing from the veins of 200,000 victims of his revenge. Despite all the brilliant achievements of the Mohammedan builders of empire, and the legacies of the great Akbar, of which British administrators know the lasting value, the sword was never sheathed, and the old saw still passed from mouth to mouth that "he who would rule India must control Cabul." Numerous were the victories of war, but those of peace were few, and in the clash of arms histories of the Indian peoples could not be written.

With the 19th century the case is far different, and my difficulties arise from the mass of interesting and reliable facts which are recorded in official reports and general literature. Before I explain the course which I shall pursue this evening, let me recall to you four decisive battles, which stand as sentinels to the century of British rule which is now sinking below the horizon. On the 23rd of June, 1757, Clive, with an insignificant force, and at a trifling loss of 72 killed and wounded, drove the Nabob Suraj-ud-daula from the field of Plassy, 96 miles north of Calcutta, and revenged the tragedy of "Black Hole" by winning Bengal for the Company. Within 31 months, Colonel Coote inflicted on Lally a disastrous defeat in 1760 at Wandiwash, took Bussy prisoner, and shattered the hopes of the French for dominion in Southern India. Before another year was passed, a foreign invader, Ahmed Shah, had on the 7th of January, 1761, defeated, on the fatal field of Panipat, the Maratta army, under Vishvas Rao, the so[n of] the Peshwa, and thus left to the British [the] task of dealing in succession with the scatt[ered] units of a confederacy, which had until t[hen] seemed likely to found a Maratta empir[e in] India. Finally, on the 23rd of October, 1[764,] Major Munro routed at Buxar the army of [the] Nabob Vizier of Oudh, Suja-ud-Dowlah, w[hich] numbered 50,000 men, leaving 6,000 of t[heir] dead on the field of battle, and capturing [...] pieces of cannon. Major Munro's mo[dest] despatch, which covered only one shee[t of] paper, and was addressed to the Earl [of] Sandwich, reached the India Office on the [...] of June, 1765, and his report that "upon [the] success of this battle depended all the C[om]pany's conquests in Bengal" did not o[ver]state the magnitude of his victory.

By these victories the door was opene[d for] the advance of the British Company to em[pire.] The country powers from one end of Indi[a to] the other were shaken. French opposition [and] intrigues had still to be reckoned with, [and] our countrymen's minds were for many y[ears] to come racked with fears of foreign invas[ion.] The Marattas again invaded Hindustan, [and] installed the Emperor, Shah Alum, on [the] 25th of December, 1771, on his throne at De[lhi,] robbed, however, by the Abdali of its for[mer] magnificence; but having laden themse[lves] with booty, they returned in 1773 to their [own] country. Thereafter they ranged themse[lves] under various chiefs with whom the Bri[tish] came to blows. The Afghan invaders [had] retired leaving behind them swashbucklers [and] adventurers, who continued for many year[s in] Rohilkand and elsewhere to add to [the] elements of turbulence. The whole cou[ntry] was a prey to the forces of disorder which the break up of the Mohammedan empire, [had] let loose upon it. Its deliverance from t[hem] was the work of the 19th century, and i[t is] difficult to crowd into a few pages even [the] most cursory account of the means by w[hich] this result was attained. All that I [can] attempt to accomplish is to draw your atten[tion] to some of the most important of the victo[ries] of war and peace won by the British on m[any] a stricken field. The removal of Europ[ean] rivals from our path, the revolution effecte[d by] the improvements of communications betw[een] Europe and India and the various province[s of] India, the establishment and maintenanc[e of] the Pax Britannica, the improvement of [the] public service, the action of the legislatu[re in] abolishing cruel rites and practices, the [ex]pansion of British India by conquest

[an]nexation, the growth of the people in [nu]mbers and wealth, the establishment of [Bri]tish suzerainty over the Native States which [ha]ve grown with the British dominion and [str]engthened with its strength, and, finally, a [sho]rt review of the material and moral progress [of] the country; these must be the topics for [our] consideration in the next hour at our [dis]posal. As far as possible I shall refer to [sto]ries and biographies, so that we may [ap]proach the subject through the medium of [per]sonality, and thus see the builders of the [Em]pire at work.

[W]e are so accustomed to the use of phrases [suc]h as "Mervousness," "Russophobia," and ["F]rancophobia," and so prone to exaggerate [our] own resources that it requires some effort [of i]magination, and a detachment from present [sur]roundings, in order to realise the dangers to [wh]ich our countrymen were exposed in India [at] the commencement of the century. Face [to] face as they were with the forces of [dis]affection, and engaged in hostilities with [the] native powers, they could never afford to [clo]se their eyes to the imminent risk of attacks [upo]n their possessions, both by sea and land, [proj]ected by their foreign rivals. The expulsion [of] Dutch and French competitors from the field [occ]upied their vigilant attention throughout [thr]ee-fourths of the 19th century, and during [the] first quarter of it involved very serious effort. [If] we would realise to-day what life in India [me]ant in 1800 and thus grasp the full measure [of t]he relief afforded by the work of the succeed[ing] hundred years, we must estimate at its [cur]rent value the impression which the native [pri]nces and the population generally formed [of] the Dutch and French power. Otherwise we [can]not appreciate the strain upon the resources [of] the Company which a well-grounded fear [of] foreign intervention entailed. Looking back [acr]oss the century, we know that the tide of [Fre]nch influence began to ebb at Wandiwash, [an]d that the battle of the Nile fought on the [1st] and 2nd of August, 1778, when Nelson [des]troyed 11 French ships of the line in [Ab]oukir Bay, together with the successes [gai]ned at Acre and in Egypt over Buona[par]te's troops, ranked as decisive battles of [Ind]ia. But neither Englishmen nor Indian [pri]nces could then realise the full meaning of ["s]ea-power," or the importance of events [whi]ch were occurring out of sight on another [con]tinent. An incident, which came to light [afte]r the capture of the Fortress of Seringa[pat]am by General Harris on the 7th of May, [179]9, will serve to illustrate the position by exposing to view the plans which Tippu Sultan founded upon his appreciation of French influence. A certain adventurer named Ripaud, the captain of a French privateer, reached Mangalore, and thence proceeded to Mysore, boasting himself to be an emissary from the French Directory. He was taken seriously, more seriously than his credentials warranted, by Tippu, and the scene at which this impostor and a few other Frenchmen of indifferent antecedents enrolled the Sultan with tawdry insignia, kisses, and extravagant language as "Citizen Tippu" disgusted the Court at Seringapatam, and has become a laughing stock to posterity. But Tippu kept to himself the negotiations, and after the siege the following note, written in the Sultan's own hand, fell into the possession of the English. It is interesting, in its reference to the history of Scotland, as showing with what judgment Ripaud set forth his facts so as to appeal to the experience of the son of Hyder Ali, who was himself an usurper. The note ran as follows:—"The names of three islands belonging to the English are Ireland, Guernsey, and Jersey. On the island of England there was a Raja of the Coossees (no doubt this was Tippu's translation of Ecossais) a hundred years ago, whom the English Raja put to death, and then took his country. What occurs to me is to retain the Frenchman Ripaud as a Vakil, ostensibly as a servant, and purchase his ship, load it with pepper and merchandise, and send it with despatches. Madras must be destroyed, Goa annexed to Mysore, and Bombay given to the French." Tippu's scheme was split upon the rocks by General Harris, and there is something of irony in the name which the military station of Hirode, formerly occupied by the French soldiers in the service of Hyder Ali and his son, still bears, namely, "The French Rocks." But the tale illustrates the spirit of unrest and intrigue which the presence of foreigners encouraged, at a moment when the Company's officers were heavily taxed in their efforts to establish peace and a sure confidence in the stability of the British power. Their masters were clamouring for revenues; Parliament had only lately, in 1793 (Section 42 of 33 George III. c 52), expressed the pious opinion that "to pursue schemes of conquest and extension of dominion in India are measures repugnant to the wish, the honour, and the policy of this nation," and the civil officers in daily conflict with famines, and the gangs of robbers

that infested their districts, were crying for the ways and means of civil administration. But what could be done, so long as hostile European advisers organised armies for the country princes, and persuaded them to attack the British dominions?

So it happened that, long after the victories of Wandiwash, Seringapatam, and the Nile, French influence had to be driven point by point out of India. At Aligarh, in the north, Lake, in 1803, met Maratta contingents drilled by the French sailor Perron, who secured terms for himself by a base surrender of his trust. At Assaye, in the centre of India. General Wellesley encountered, on the 23rd of September in the same year, considerable French forces, under Dupont and other French officers, fighting with the allied armies of Sindhia and Bhonsle. Louis Bourquin had to be reckoned with at Delhi, the Chevalier du Drenec was defeated at Laswari, and Col. Saleur was, at a later date, found in command of a contingent of the Begum Sumru. When troubles thickened in the Punjab, General Ventura, who, though an Italian by birth, held the rank of colonel in the French Army, placed his military talents at the disposal of Ranjit Singh, and Jean François Allard, who had fought against us at Waterloo, not only served as a general in the Sikh army, but also held the position of political agent of the French at Lahore. Again, when the century had passed its third quarter, the same danger rose to the surface on another sea of Indian difficulties. When Thebaw, King of Burma, proclaimed on the 7th of November, 1885, to his subjects his determination to efface "the heretic foreigners and to conquer and annex their country," he relied, as Tippu before him had done, upon French support. Those who are curious to examine how far history repeats itself can consult the papers published in Blue-book No. 4,614 of 1886, which throw light upon the negotiations of Ava with France. There it will be seen that the Viceroy, on the 29th of July, 1885, expressed the opinion that, if the arrangements were concluded, "French agents would dominate all trade and chief sources of revenue in Ava, and the consequences to British trade and interests would be disastrous."

I cannot pass from this final scene in the contest between French and English influence, which was exhibited on the stage of history in the 19th century, without advertence to recent apprehensions of a possible invasion by a European power from the north-west which are not overlooked by the Brit rulers of India, and which, at times, dist the minds of the native population. For nately, nature has interposed almost insup able obstacles in the way of its realisati and this new danger, while it should pass without notice in this review, has ne reached the intensity which characterised fear of French interference which our cestors had to dissipate a hundred years ag

The French were not the only rivals moved from the path of the Company in last century. The Dutch held the Cape the road to the East, and although Clive h in 1759, frustrated their attempt to introduc European force into Chinsurah, that set ment on the Hugli was still, in 1801, owned the Dutch. It will be remembered that th was no war between the Dutch and the Engl when Clive, who was seated at cards, recei a letter from Colonel Forde, asking for writ authority to attack the Batavian force. Wi out rising from the table, he wrote on the ba of a card the following order in pencil:—"D Forde,—Fight them immediately. I will se you the Order in Council to-morrow." Fo accordingly fought and defeated the Dutch half-an-hour. The battle was hardly w when ample justification of Clive's foresi was supplied by the appearance of the Nabo son with an army, which was intended to operate with the Dutch, who had been secre encouraged by Mir Jafar to send the for Forty years after these events the Dutch l their settlements in India, but they recove them under the treaty of August 13, 18 Subsequently, under the Treaty of Lond March 17, 1824, by which Sumatra was ce to the Netherlands, all Dutch establishme in India, including Chinsurah, Balasore, a Dacca, were given up to England. A few the Dutch joined the ranks of soldiers of tune, and one of them, George Hessing, commandant of Agra Fort. Cape Town, a its capture by us, had been restored in 180 the Dutch after the Peace of Amiens, bu was retaken in 1806, and British sovereig was permanently established there in 18 Thus the approaches to India, as well as continent itself, were cleared of the Dutch the 19th century. It was not, however, unt later date, namely, 1845, that the possessi of the Danes were acquired by peaceful mea In 1801, Serampur, then called Frederic nagore, and Tranquebar had been captu from Denmark, but they were restored that nation under the Treaty of Kiel in 181

The Company were not only successful in earing India of European rivals, and in :curing possession of the Cape, they also :evented Aden and Perim, at the entrance to e Red Sea, from falling into the hands of rance. At first an offer of Aden was refused, it in 1839 the rock was captured from the rab chief who held it as the port of Lahej. erim was actually occupied by a British force, hich arrived from Bombay on May 3, 1799. ut the sufferings of the garrison led to its andonment as soon as the immediate risk of rench invasion was removed. In 1854, a rench engineer, named M. Lambart, visited id surveyed the island, and indiscreetly gave it that he had recommended the French overnment to occupy it. But before any eps in that direction had been taken by the rench, General Coghlan, in January, 1857, espatched Lieutenant Templer from Aden to sume possession of the island, and it has /er since remained under British rule. The opular story which credits General Coghlan ith outwitting the garrulous commander of a rench brig-of-war, which put into Aden on its ay to occupy the island, has no further undation of fact than the coincidence of the rival of the French ship at Aden on the 11th January, 1857, just as Lieutenant Templer as about to carry out instructions which he id previously received, and which were dated ecember 17, 1856. On this subject I may fer you to Lieutenant Low's account of the idian Navy.

By these means India and its approaches ere cleared of foreign competitors, and the iccess of the British is the more creditable hen we consider the disadvantages under hich the builders of the Empire laboured in ie matter of communications with the Mother ountry, and with their various settlements in idia. The development of communications perhaps the most far-reaching of all the chievements which the present century has itnessed. One can only realise the depth of ie gulf which separates 1800 from 1900 by welling on this incalculable difference. On ctober 6, 1800, Lord Wellesley wrote, "In the esent year, I was nearly seven months withit receiving one line of authentic intelligence om England. Speedy, authentic, and regular telligence from Europe is essential to the nduct of the trade and government of this mpire." It needs no gift of imagination to cture the embarrassment which it caused to e King's and the Company's officers in idia to be left in the dark at a time when wars and treaties of peace were succeeding each other with marvellous rapidity in Europe. Often the Governor-General was obliged to prepare for hostilities which did not break out at the time or in the quarter expected; and, again, hostilities continued or commenced, as in the case of Chinsurah already referred to, on the Indian seas and continents when peace existed in Europe. The difficulty of Indian administration did not end there.

The absence of speedy and regular communication with Europe delayed the arrival of the Company's officials, aggravated the sufferings of those who were invalided home, and rendered life in India a real banishment, with all the bad effects which must result from the severance of the East from the West. Some incidents which I shall here enumerate will give a graphic picture of these consequences. In a letter written by General Harris from Dum-Dum to Colonel Dirom, on June 3, 1796, in reply to the Colonel's letter of September, 1794, I lately read this sentence:—"I might say that your letters not reaching me for a year after they were wrote made their contents of no immediate consequence." No power of imagination is needed to bring home to our minds the sundering of home ties which such delays produced. They were frequently caused by detours due to the necessity for escaping the enemy's cruisers. The voyage of Sir George Nugent, who was Commander-in-Chief in 1812, illustrates forcibly the tedium, danger, and ill-temper which a voyage to India, now undertaken by Englishmen as a pleasure trip, involved in the beginning of the 19th century. After several false starts, the East Indiaman *Baring*, which carried Sir George and Lady Nugent and other military and civil servants of the Company, finally left this country on the 20th of July, 1811. The Commander-in-Chief reached Calcutta on January 11, 1812. There were constant fears of falling in with ships of the enemy, a danger which the *Baring* was more fortunate than other vessels in escaping, although off the island of Cape de Verd considerable danger was run. Thus the *Streatham*, which carried Mr. Bevan in 1808, met the French cruiser *Piedmontese*, in the Bay of Bengal, cleared for action, and fortunately so imposed upon the Frenchman by its brave show, that it escaped an engagement. Major Bevan, in recounting his adventures, remarks: —"Though the Company's ships were built expressly for trade, they were never backward in encountering an enemy." To return, however, to Sir George Nugent's voyage. Although

the *Baring* fell in with no foreign enemy, there was no lack of fighting and quarrelling on board. The sailors fell out with the soldiers, the officers knocked down their men in bad temper, and the passengers quarrelled amongst themselves. Lady Nugent, after having shut herself up on board, in order to avoid the company of her quarrelsome fellow-travellers, endured an agony of distress when, on arrival at Sangan Island, her friend Captain Fraser was compelled to fight a duel with Captain Templar. Both fired together and neither was hurt, but it does not appear that on their return to the ship harmony was restored.

The experiences of Lady Nugent were not unusual. Mr. Bevan left home for India in January, 1808, and arrived at Calcutta at the end of July. Twenty-four years later he returned to Dartmouth by the Company's ship *Sir Edward Paget*, leaving Cannanore on January 11, and arriving on May 2nd. Official news travelled faster than passengers, but slowly in comparison with our modern experience of overland routes, Suez Canal, and submarine telegraphs. The news of Seringapatam, fought on the 4th of May, 1792, reached London on the 13th of September, Fort St. George on May 15, and Fort William on May 17. The despatch containing an account of the attempt upon the life of King George III., which occurred on May 15 at Drury Lane, reached Calcutta on the 30th of September, 1800; and the important Treaty of Bassein, signed in Western India on the 31st of December, 1802, only arrived at Calcutta on the 28th of January, 1803, the day on which it was ratified by Lord Wellesley.

It is an old saying that "evil communications corrupt good manners." Society suffered in various ways from its sense of isolation. An extravagance more Asiatic than English was cultivated by the British nabob; men who had lost touch with home were apt to be selfish in the presence of ladies, or prone to lapse into Indian ways; and the distance which separated control from local action tended to insubordination. The Governor-General gave a grand evening party at Calcutta on January 26, 1803, in celebration of the news regarding the Peace of Amiens. I should occupy your time too much if I attempted to describe the decorations under which the supper table groaned. But I may mention that there was a galley bearing the news of peace, a frigate decorated with every conceivable colour, some curious Egyptian obelisks covered with hieroglyphics, and a temple emblematic of peace, which reste on eight Corinthian pillars, supporting fou pediments ornamented with painted scene and surmounted by a dome. The scene were well chosen, and pictured the nava battles of Cape St. Vincent and the Nile the capture of Seringapatam, and the landin of the Indian contingent in Egypt. Th allegorical transparencies, illuminated arche and temples which adorned the grounds re called the descriptions given in Arabian tales and Lord Lytton's pageantry at the Imperia assemblage at Delhi in 1877 was but a tam affair in comparison. Mr. Tennant, in hi "Indian Recreations," dwells on the extrava gance of private houses, and remarks in fin language: "By such splendid festivity ar the evenings of the Europeans exhilarate after the lassitude, fatigue, and debility c the day." Some of the dishes of the da would not now have an exhilarating effec as, for instance, a soup made of the nest of birds brought from Java. Native gentle men, such as the Nawab of Chitpur, wer equally profuse in their hospitality, and according to the accounts of their guests very partial to cherry brandy. In going t their dinners appearances were cultivated Coaches and four were ordered out for th shortest distances, and on the brightest c moonlit nights a large retinue of linkmen ra in front of them.

Various instances might be given to sho how the want of contact with English societ and home-life encouraged selfishness amongs men, and a tendency to adopt Asiatic ways Poor Lady Nugent was so bored with her sta at Murshidabad that she recorded in her diary "I feel great relief in the reflection that th gaieties of the last station are over." Althoug she particularly disliked the smell of th hookah, she was forced to endure a volcan of hubble-bubble on each side of her. Mrs Palmer joined the men in smoking a hookah and lavished all her art upon the decoration c the stem, which was attached to a gold mouth piece. Confirmed Anglo-Indians, such a Gardiner and Fraser, wore long beards an whiskers, in Sikh fashion. Bishop Hebe tells a story of a French colonel whom he me at Agra in 1825, who dressed his daughters i native fashion, and kept them secluded in th zenana. They married European officers, bu no suitor was admitted to a sight of the fai ladies until he had first promised to marry on of them. On that understanding he entere the zenana to make his choice. Feelings ros

gh in the absence of the means of timely planation, and Lord Wellesley did not sitate to describe his masters to Lord Castlereagh as the "loathsome den of the India fice," the home "of vindictive profligacy," d "a faction from whose ignominous tyranny expect every practicable degree of injustice d baseness."

The East could hardly understand or keep ich with the West when it took more than a ar to exchange ideas between them. A aint light is thrown upon the early days of 19th century by a collection of "Selections m *Calcutta Gazettes*," from 1784 to 1805, blished in Calcutta, 1864. It consists of racts from a weekly paper, *The Calcutta zette and Oriental Advertiser*, which was blished under the authority of Government. ggrel rhymes, translations of Sanskrit or rsian poetry, and tedious, stilted essays fill the columns in default of news from home. dless lotteries, and accounts of races, squerades, and plays, reveal the social usements of our ancestors, while advertisents for the recovery of runaway slaves and nouncements of duels throw light upon their mestic trials. On the official side news is blished regarding the progress of European rs, a scheme of lottery for building the lcutta Town-hall at a cost of 5 lakhs, public ns, and the desire of the Governor-General entertain all gentlemen of the civil and litary services of His Majesty at banquets, ening parties, or the subdued festivity of a blic breakfast. The appearance of the ekly paper was eagerly awaited, but when think now of the general excellence of the glish Press in India, we can only marvel at scant diet with which our ancestors had to ntent themselves.

We know how all this has been changed in nsequence of the annihilation of space and e by wires, rails, and the influence of steam. e corner stone of the British Empire is the ularity and speed of its communications. e Commander-in-Chief, who left Calcutta July 2, 1812, to visit the outposts of Bengal, ing with him a hundred boats for his transt, was thought to have accomplished a id journey to Cawnpore in eleven weeks. pace was altered twenty years later, when d William Bentinck ordered steamboats to built, which performed the journey to ahabad in three weeks. In 1843, Sir cdonald Stephenson proceeded to Calcutta behalf of a company to advocate the conction of railways. The Court of Directors, on the 7th of May, 1845, wrote a dispatch, which laid down the first outlines of a railway policy, and Mr. Simms was sent out to assist in its execution. The first line opened to traffic in India was that which linked Thana to Bombay on the 18th of April, 1853. There were present at that ceremony civil officers, who had been the first to teach the people to substitute wheels of wood for those of stone, which had been until then universally used by the country carts. There are now 23,000 miles covered by the iron rail, and open to traffic. In December, 1851, the first telegraph was laid for 30 miles, from Calcutta to Diamond Harbour, and by the 1st of February, 1855, the lines between Calcutta and Bombay, *viâ* Agra and Meerut, between Meerut and Attock, and Bombay and Madras, were opened to the public. There are now 52,000 miles of telegraph wire in India. Steadily throughout the country has the work of making roads and canals proceeded, so that every district has an excellent network of easy communications. By these means Lord Dalhousie was enabled, in 1853, to establish a public post between all parts of the Empire at a uniform rate of half an anna.

If we turn to the means of communication between England and India we find the same marvellous revolution. It was considered to be a great achievement when, in 1797, regular monthly communication was established with London, *viâ* Bussora and Aleppo. Every letter required the countersignature of a Secretary to Government. Its size was limited to 4 inches long by 2 inches broad, and wax sealings were not allowed. The rate was ten rupees for a single letter. We now have a penny postage between England and India; 7,000,000 of letters and post-cards are annually carried both ways. Steam communication and the opening of the Suez Canal have effected this change. For some time the Court of Directors looked coldly upon the new movement. In 1830, the steamship *Hugh Lindsay* left Bombay for Suez, which it reached in a month, but the Court objected to the expense, and for some years India had to wait for the establishment of its mail service to Suez. In 1843, the Peninsular Company sent their first steamer, the *Hindustan*, to India by the Cape, and two years later they undertook the mail service to Calcutta. It was not until 1854 that the East India Company resigned the service between Bombay and Suez into the private Company's hands. Even then between the Mediterranean and the Red Sea there still

remained an interval of 90 miles of land transit from Cairo to Suez, through which the conveyance of each steamer's loading required a caravan of 3,000 camels. The Suez Canal, with its distance of 87 miles, was opened for traffic on November 17, 1869, and the Company's fleet was reorganised until it now consists of steamers aggregating 300,000 tons, which have cost £7,000 000. And this great Company is only one of many engaged in linking the resources of Europe with our Indian empire.

Limitations of space forbid my offering more than a few comments upon the relative advantages and disadvantages of rapid and cheap communication with the East. On the profit side there is the obvious gain of quick concentration of resources upon points of danger. Military forces are not scattered, but held in readiness to act with overwhelming strength and rapidity where occasion requires. England's and India's hands are joined across the seas by submarine wires and steamships. At the same time the connection is artificial and easily snapped. Self-reliance is weakened by a habit of anticipating help from another quarter. The economy of steam-power reduces the demand for, and the supply of, animal transport, which it may become difficult to procure in a crisis. The 3,000 camels required by a single company for every trip from Cairo to Suez, represented only a small item in an asset of incalculable value for the conduct of military operations, which steam has dissipated. The political effects of closer communication are equally open to criticism. Just as the Suez Canal is held to have altered the temperature of the Red Sea by letting the cooler waters of the central main into it, so the healthy public opinion and social tone of England are being perpetually carried to India along the channels of rapid transit. On the other hand, the Governors of India have now to watch two barometers of Eastern and Western opinion, and the virtue of safety, so often associated with mediocrity, is preferred in the ranks of the executive to the strength of individuality and resourcefulness. The East and the West no doubt can now understand each other better, and even the tourist of a cold weather season brings and takes with him useful knowledge. On the other hand, catch-words pass to and fro so rapidly that those with a base ring are mistaken, in the hurry of exchange, for sound coin. Eager as free men must always be to see the British Government of India broad-based on the intelligent co-operation of the Indian peoples, and o[n] principles of self-government, they are slow t[o] inquire whether Hindu advocates of representative institutions are merely repeatin[g] parrot-cries, or mean what they say. Ar[e] these advocates anxious for the good of India or do they seek larger powers to be employe[d] for their own advantage? Are they resolutel[y] opposed to social reform, even expelling socia[l] reformers from their political congresses? D[o] they thwart measures for the education [o]f the masses, and consider themselves pollute[d] if they sit on the same bench with honest me[n] of low caste? When communications ar[e] abnormally quickened, inquiries of this sort ca[n] hardly keep pace with them. Yet, if stea[m] and electricity are pouring new wine into th[e] East, with its patient deep disdain of th[e] Christian West, it is necessary that ne[w] bottles should be prepared for its receptio[n]. This provision, however, takes time, an[d] we dare not forget that Buddhism onc[e] seemed to have won the day, but after [a] thousand years of struggle caste resumed i[ts] tyranny.

So far, we have looked at India in the 19t[h] century from two side-lights. We have see[n] the British successful in removing French an[d] other European rivals out of their way, and [in] perfecting their external and internal lines [of] communication. It is time now to examin[e] the effect of our rule upon the country itsel[f]. We shall find, I think, that during the prese[nt] century peace has been enthroned in the hig[h] places of disorder; the lives and properties of t[he] people have been protected as they never ha[d] been before; and horrible rites and practices [of] centuries, condemned by the sense of civilis[ed] nations, have been abolished. To some this stat[e]ment may seem a truism requiring no witness[es] to prove it. By others it has been challenge[d]. On this side of the seas well-meaning perso[ns] have thought it politic to belittle the chang[e] wrought under our rule, in the hope of e[m]phasising the need, which cannot be deni[ed], for greater changes and improvements to com[e]. On the other side, Anglicised Indian writ[ers] have sought to awake patriotism (some I fe[ar] have desired discontent) by asserting, with[out] any historical evidence of the fact, that und[er] former dynasties India was a prosperous a[nd] contented country, free from plagues a[nd] famines. In these conditions it is necess[ary] to preface a few general remarks by givi[ng] you the means of forming your own conclusio[ns] after hearing the testimony of competent w[it]nesses who have told what their eyes witness[ed].

ıen, as yet, no political purpose was served · distorting the truth.

From a cloud of witnesses who have de-ribed the former state of Indian society, I n only select a few to illustrate the scenes ıon which the curtain rose in 1801. How few this room have ever heard of Dhondhia 'agh! His name is elbowed out of history by e competition of other scoundrels. Yet it re-ıired a full three months' campaign, con-ıcted by the future victor of Waterloo, to ush this adventurer. When Seringapatam l, Dhondhia was released with other isoners, and, profiting by the occasion, he once gathered round him a number of dis-nded soldiers, and, capturing some guns d ammunition, proceeded to harass the ıuthern Maratta country. He plundered the lages, he committed atrocious cruelties on eir inhabitants, he garrisoned forts, and fied all attempts to bring about a general gagement until Colonel Wellesley caught m on September 10, 1800, at Conaghur. ıere was no popular feeling on his side, and the present day the peasants at their village stivals celebrate in their songs the deliver-ce wrought by the British. The helpless-ss of the people, and the licentiousness of e soldiery employed by the native princes, posed all parts of India for many years to me to similar scenes, and the operations ıich history has dignified with the titles of e Maratta and Pindari wars, were nothing ore than campaigns of deliverance waged behalf of the suffering people of India by e British Government. In those days, when atitude was not silenced by political motive, e voice of India expressed its feelings in no certain sound. Major Bevan, who cam-igned in Central India, writes that every-ıere "the natives spontaneously and joyfully knowledged that our successes had bettered eir condition by affording protection to in-stry, and even several of the chiefs, whom forced to submit, derived important advan-ges from our protection."* That officer ves numerous instances to show how the ndari's route was traced by the desolation of e and sword, and how they spared neither k nor age in their wanton cruelty and refined ture. Mr. Leckie, in his "Journal of a ute to Nagpore," published in 1800, describes ectacles "at which humanity shudders" on sides, and repeats the testimony of a Brah-n who said to him at Sohnpoor:—"We sit nd you without dread and in a friendly manner. When the Marattas come we seek refuge in the hills; our herds and flocks are plundered, and our temples even are violated." The same story was repeated as British protection extended to the north-western provinces in later days. Bishop Heber on his extensive tour overheard a conversation near Maunpur between his followers and the villagers who remarked that "Grain has been getting cheaper of late years, and, although the late season was bad, it is cheaper now than in the days of trouble." At Cawnpore, his Archdeacon heard the following conversation on the 8th of October, 1824. A camp follower remarked: "It is a good rain for the bread." The Hindu replied: "Yes, and by God's mercy a good Government under which a poor man may eat it in safety!" In Meywar the people generally observed that the country never had known peace until Tod Saheb came amongst them. In Western India Mountstuart Elphinstone wrote concerning Khandesh, which is now one of the most populous and prosperous districts in India: "The districts north of the Tapti, in particular, which were formerly very populous, and yielded a large revenue, are now almost an uninhabited forest. The decline of this province from the flourishing condition which it had attained under its Mohammedan masters is to be dated from 1802, when it was ravaged by Holkar, and its ruin was finally consummated by the misgovernment of the Paishwa's officers." Of that misgovernment he gives these instances:—"Some Jageerdars and Zemindars made a trade of harbouring robbers, and any offender, it is said, could purchase his release if he had money enought to pay for it." "The Mamledars would frequently release Bheel robbers, and allow them to renew their depredations on payment of a sum of money."

Let any one who doubts the misery of the country at the beginning of last century read "Colonel Sleeman's Rambles," and the Blue-books presented to Parliament on the subjects of slavery and famines. Let him observe the crumbling walls and broken fences of prickly pear, which once were maintained for the protection of the villagers at night, but which are now no longer required. Let him read official reports on the long drawn out contest of the British with Thugs, Megpunnias, dacoits and river pirates. Let him ask why the revenue was collected under native rule by armed forces and Mulkgiri expeditions. How were the officials then paid, and why was the competition for the post of Mamledar or Tehsildar so keen? Was there ever, as in the

* Major Bevan's "Thirty Years in India." vol. i., 328.

dark days of the Middle Ages in Europe, a Church or a feudal nobility to protect the people from the avarice or tyranny of their rulers? We know, on the contrary, that the Hindu religion placed a gulf between the high caste and the lower caste, and permitted slavery. There was no feeling of the sanctity of human life, or of chivalrous honour due to women. Both within the family circle, and in society at large, the spectacle of suffering moved no pity. Travellers tell us of plentiful sport in Northern India where lions were constantly met on the march. To-day there are hardly ten lions in the whole of the empire, and their haunts are confined to the Gir forests. Without dwelling any longer on the picture of desolation, I shall proceed to trace briefly the process by which the land was brought out of darkness into light, and from anarchy to peace and order.

In the first place, it was by our own Western hands, by the agency of a pure European Civil Service, that reforms were introduced. The experience gained in the 18th century in Bengal showed that salvation for India could be effected by no other means. When Bengal fell to the East India Company as the result of the victory of Plassey in 1757, for nine years the Company confined itself to the exercise of military control, leaving the civil government to the Nabob. From 1765 to 1769 the Company added financial control to its responsibilities, but it took no part in the administration of justice. In 1769 there occurred a great famine, in the course of which 3,000,000 of the inhabitants perished. The absolute powerlessness of the native administration was painfully brought home to the Government, and in 1772 three collectors were appointed, and the old order of a mercantile service, with its factors, merchants, and storekeepers, gave place to the administrative corps known as the Civil Service of India. How that service was built up in the 19th century I can only briefly narrate. Lord Wellesley foresaw the high vocation to which its members would be called. His Regulation, dated July 10, 1800, for founding a college at Fort William for the better instruction of junior servants of the Company, struck the key-note of the noble Proclamation of 1858:—"Whereas the sacred duty, true interest, honour, and policy of the British nation require that effectual provision should be made at all times for the good government of the British Empire in India, and for the prosperity and happiness of the people inhabiting the same." Throughout his term of office he continued the good work begun by Lord Cornwallis in clea ing the service of abuses. His plans were n approved by his masters, but they led to t institution of Haileybury College in 18c After half a century that scheme of recru ment was succeeded by a system of publ competition, and the 19th century has n neared its close without seeing the lists successful candidates for the service of Ind filled from the ranks of the best scholars of t day sent forth from the universities and t schools of the United Kingdom. The builde of the Indian Empire have not been excl sively drawn from the Civil Service. The pi of the armies of the Company and of t Queen have contributed to the structure, a few names have won for their possessors mo eminent recognition at the bar of public opini than those borne by soldiers who have fill posts of honour in the political and ci departments.

Side by side with the measures taken f improving the tone and qualifications of t European servants of Government, the nativ of India have been educated and train according to Western standards, and tak into partnership in the work of administratio Thus, while it is still necessary that a thousa civilians from the United Kingdom shou control, supervise, and direct the publ administration, there are now many tens thousands of Indians who fill responsible pos and help to bear up the pillars of State.

Throughout the past century the movi finger of the Legislature has written on, a helped the Executive Government to remo the worst abuses that darkened the 18 century. Lord Wellesley, on the 20th August, 1802, enacted a Regulation for pr venting the sacrifice of children at Saug and other places on the Ganges, by exposi them to be drowned or devoured by shark He also instituted inquiries into the pr valence of Sati, and ascertained that b tween the 15th of April and the 15th October, 1804, no less than 116 widows h been immolated within 30 miles of Calcutt But so great was the prejudice against int ference, that it was not until the 4th December, 1829, that the practice was declar to be illegal in Bengal, and in the followi year in Madras. In 1808 a Regulation w passed for the apprehension of traders a others concerned in gang robbery, and for ma years afterwards the law was strengthened a improved.

In 1820, the practice of illegal duress

dividuals, chiefly Brahmans, for extorting oney or obtaining rights, known as Dharna, as made punishable without the tedious foralities which had until then frustrated justice. ishop Heber gives an interesting account of e practice of Dharna on a large scale in enares when the House Tax was imposed, id 300,000 people left their shops and fasted the plains. In 1811, the importation of aves from foreign countries was forbidden; it doubts arose as to whether the prohibition plied to the case of slaves removed from any rt of the British possessions acquired after e year 1811, and therefore, in 1832, a Regution was passed to remove those doubts and stop the removal of slaves for traffic from e part of the British territories to another. it domestic and agrarian slavery still conued, and it was not until 1843 that the enrcement of any rights arising out of alleged operty in human beings was finally barred. iugs were dealt with in 1836 by Act XXX., ich punished with imprisonment for life any e proved to have belonged to any gang of iugs. In 1850, the principle of religious utrality was tardily extended throughout dia, by enacting that the renunciation of exclusion from caste was not to affect rights property or inheritance. This valuable easure of religious toleration has not yet, regret to observe, been extended to the ative States. Amongst other legislative ts, I may note the subjects which low as marking some leading footprints the sands of time — namely, the rearriage of Hindu widows, in 1856; the celeated Indian Penal Code, 1860; the marriage Christians, in 1864; the murder of female fants, in 1870; the treatment of criminal bes, in 1871; the statutory rules of 1889 garding Lewa kunbis; the amendment, in 91, of Section 375 of the Indian Penal Code, as to protect infant wives; the Factories nployment Act, in the same year, and the pers Act of 1898. If it should be thought at the Indian authorities have been slow in nishing rites and practices abhorrent to estern feelings, the principles set forth in Queen's Proclamation, and referred to in gulation XVII., 1829, must be borne in nd. The Company's Government then recited considerations which induced them to stop practice of Sati as revolting to the feelings human nature, "without intending to depart m one of the first and most important nciples of the British Government in India, t all classes of the people be secure in the observance of their religious usages, so long as that system can be adhered to without violation of the paramount dictates of justice and humanity." Happily, the forces of improved communications, of education, and of moral and material progress, have tended steadily, if slowly, throughout the century, to draw the West and the East more nearly together. Nevertheless, it is well to remember that men may repeat the commonplaces of social reform, and yet, conscious of their own interests, be slow to translate their parrot-cries into legislative action. For further progress in social matters, in sanitation, housing of the poor, the education of backward classes, and ameliorations of the conditions of labour, the British official in India must still rely upon himself and the support of Western rather than of native public opinion.

The growth of population and the means of collecting accurate statistics of their numbers and conditions afford in themselves a test of good government. In this respect, as in others, the 19th century has spanned the interval between ignorance and knowledge. Notwithstanding all that the great Akbar accomplished, he failed to enumerate the peoples of India or even the inhabitants of his 15 Subahs. So late again as A.D. 1801 it was impossible to tell the population of the provinces under British rule. Tennant, a careful writer, in the edition of his "Indian Recreations" dated 1804, states as follows:—"The dominions of the East India Company therefore contain a population of not less than 50,000,000 of souls." But somewhat indiscreetly he gives his reasons, and they do not carry conviction. They throw, however, a very significant light upon the utter helplessness of the times. Taking Bengal alone he found that in one district, that of Purnea, the cultivators and artificers multiplied by five, so as to represent an average family, represented a population of 2,003 to the square mile, which for the whole area of Bengal gave 33,000,000. Again, he found that 10,000 cultivators actually tilled an average of about 18 beegahs of land. He allowed 11 artificers for every 40 cultivators, and taking the whole number of cultivated beegahs worked out his result at 33,591,000. Another of his calculations was based on the fact that 68,647 leases gave an average of 7 rupees to each tenant. The receipts for the first year of the permanent settlement would thus require 6,064,688 tenants who, with five to the family, made up 30,000,000. Finding again that the sales of salt annually amounted to 3,532,000 maunds, and that each

individual needed nine pounds, he concluded that the population was over 32,000,000. His last calculation was based on the produce of cultivated land. As the result in each case worked out to 32,000,000 or thereabouts he accepted that figure as correct. For the company's later acquisitions in the south he gave the barest estimate, but he concluded with the remark that "it is not pretended that an accurate state of the population can be given."

When on the 17th of March, 1841, the Court of Directors voted a statue of the Marquess of Wellesley, it was claimed for him that he had added to the Company's possessions 140,000 square miles of territory, 40,000,000 of subjects, and nearly 10,000,000 sterling of annual revenue. The Court's estimate was evidently far in excess of Tennant's figures. In 1854 Thornton calculated the population of British India at 107,173,000 souls, and that of the Native States at 54,580,000, but especially in regard to the latter item these figures were more or less guesswork. On February 17th, 1881, the first synchronous enumeration ever attempted in the history of India was taken, and even then Kashmir was excepted. I can well recollect the apprehensions to which the project gave rise, and the care taken to prepare the native mind for it. Notwithstanding these precautions, troops were actually called out to pacify the Sonthals in Bengal, and in the west the Bhils evinced such a repugnance to the census that our enumerators contented themselves with a mere estimate made at a safe distance. A suspicion that the measure was a prelude to fresh taxation was widely entertained, and in many parts of the country a general conscription was feared in view of the Afghan war. The entire population then enumerated was 253,891,821 souls, inhabiting an area of 1,386,624 square miles. Ten years later, on the 26th of February, 1891, the enumerators found 287,223,431 souls living in India, including Aden, on an area of 1,560,160 square miles, of whom 66,050,479 were in the Native States. But if we compare the figures of 1881 and 1891 for the same area of enumeration, the increase at the later date is represented by 27,821,420, a number then exceeding the whole population of England. This growth of population at the rate of 9.70 per cent. annually in British India was accompanied by other symptoms of prosperity. Karachi and Rangoon, two thriving centres of commercial activity, had increased their population in the decade by 43 and 34 per cent. respectively. Cities generally had gained upon the country. The consumption of salt throughout th Empire showed a mean increase during the te years of 13 per cent., while letters and tel graph transactions were heavier by 56 per cen Post-cards increased more than three-fol throughout the decade. The net earnings railways showed an average advance of 37 p cent.; the volume of trade mightily increased notwithstanding the checks of famine the r venue rose continuously; and India absorbe Rx 89,000,000 of silver, and Rx 41,000,000 gold between 1881 and 1891. We are now c the eve of another census, but to the credit the 19th century must be carried the r markable achievement of two censuses of th people with the masses of information the collected, and the completion of "The Ir perial Gazetteer of India" by Sir Willia Hunter.

The territorial growth of India is shown the following notes. Before the century dawn Bengal and Madras were fairly strong, and th former had gained in 1800 the Mysore distric ceded by the Nizam. To Bengal, Oris was ceded in 1803, and certain Nagpur distric in 1818. The island of Bombay gathered rou it in 1817 to 1819 the Deccan and Guzerat, b had to wait until 1843 for Sindh. The Nort Western Provinces received part of their distric in 1836 from Bengal, part from Oudh, a lit from Nepal, and finally the rest of Oudh 1856. In turn they surrendered districts to t Central Provinces, which gained Nagpur 1853, and after the Mutiny two districts fr Gwalior and Hyderabad in exchange for othe The Punjab sprang into life as a British pr vince after 1849. Assam was detached fr Bengal in 1874, and Burma, the largest of Indian Provinces, acquired its principal ad tion in 1885 under the rule of Lord Duffer Altogether the 19th century has witness the expansion of British India from three P sidencies, of which one was little more than island, into eight large, and five small Brit provinces.

Growth of British India in the 19th Century.

1801. The Carnatic.—The Nabob, by treaty da July 31, 1801, handed over the wh administration to the United Company Merchants of England, trading to the E Indies.

,, Gorakhpur, Bareilly, Allahabad, and ot districts.—The Nawab Vizier of O ceded these districts on November 10, 18 in commutation of the subsidy.

3. Bundelkhand. — Certain districts were ceded by the Peshwa under the Treaty of Bassein, December 31, 1802, for payment of a subsidiary force, and on December 16, 1803, they were exchanged for others.

Kuttack and Balasore. — Acquired from the Raja of Berar.

Delhi territory and Doab, between the Jumna and Ganges, as well as Ahmednagar.—Conquered from Sindhia, and ceded by Treaty of Sarje Anjangaon, December 30, 1803.

5. Part of Guzerat.—Ceded by the Gaekwar of Baroda, under the Treaty of April 21, 1805, for maintenance of a subsidiary force.

5. Kumaon, Dehra Dhun, Simla.—Acquired by treaty of peace with Nipal, done at Segowli, December 2, 1815.

7. Dharwar, Kattiawar tribute, parts of Konkan.—Ceded by Treaty of Poona, 1817, with Peshwa.

8. Khandesh, Poona, and the Maratta country, Ajmir, and districts on the Nerbada.—Ceded under various treaties by Holkar, the Peshwa, Sindhia, and the Raja of Berar.

9. Vingorla and part of the Konkan.—Ceded by Treaty of February 17, 1819, by the Raja of Savantvadi.

4. Singapore. — Acquired from the Raja of Johore.

5. Malacca, &c.—Obtained by exchange from the King of Holland.

6. Assam, Arracan, Tenasserim, Tavoy, &c.—Ceded by treaty of peace, dated February 24, 1826, with the King of Ava.

30. Cachar.—Lapsed on the death of Gobind Chandra.

34. Coorg.—Acquired by conquest.

39. Aden.—Captured on January 19, 1839, from the Sultan of Lahej.

43. Sindh.—By the victory of Miani over the Amirs, Februaay 15, 1843.

45. Seranpur and Tranquebar.—Purchased from the Danes by Treaty of February 22, 1845.

49. Satara and the Punjab.—Satara was acquired by lapse, and the Punjab by conquest.

2. Rangoon and Pegu.—Rangoon was captured April 14, 1852.

3. Nagpur.—Lapsed on the death of Raghoji on December 11, 1853. In 1861 Nagpur, Saugor, and the Nerbada territories were formed into a separate province, and placed under a chief commissioner.

6. Oudh.—Annexed in February, 1856, when the king was pensioned.

0. Nimar and Panch Mahals.—Acquired by territorial exchanges with Sindhia and Holkar.

1878. The Peint Estate.—Acquired by lapse.

1883. The district of Quetta made over by the Khan of Kelat by agreement dated June 8, 1883.

1885. Upper Burma.—Mandalay was occupied on November 28, 1885, and Upper Burma was annexed by Lord Dufferin's Proclamation of January 1, 1886.

The establishment of British suzerainty over the Native States, and the preservation of native rule over 65,000,000 of Indians, and in an area of 604,717 square miles must take rank as one of the great achievements of the present century. Such a result affords the best practical proof of fidelity to the principle set forth by the Secretary of State in 1860. "It is not by the extension of our Empire that its permanence is to be secured, but by the character of British rule in the territories committed to our care, and by demonstrating that we are as willing to respect the rights of others as we are capable of maintaining our own." Various policies were pursued in different periods of the 19th century. Until the close of Lord Minto's rule, in 1813, it was esteemed the wisest course to avoid all relations or entanglements with the States outside the ring-fence of the Company's territories. The result was that anarchy took possession of the free field, and that adventurers, both European and Asiatic, licentious soldiery, and gangs of robbers, made them their playground. Peace within the Company's dominions was impossible with such disorderly neighbours, and so, between 1813 and 1857, Loid Hastings and his successors undertook the task of a general political settlement. The native chiefs were required to entrust the conduct of their external affairs to the Company, to regulate their armaments so as to avoid danger to themselves and to others, to employ no foreigners without permission, and to fall in line with the British in abolishing slavery, infanticide, Sati, and other inhuman practices. For the rest, they were left to themselves, and on failure of heirs the Company reserved and exercised the right of annexation. After 1857, this right of lapse was surrendered under certain conditions, and adoption Sanads were given to the ruling chiefs in pursuance of Her Majesty's desire that their governments should be perpetuated, and the representation and dignity of their houses continued. Parliament took cognizance of the Queen's suzerainty (52 and 53 Vic. cap. lxiii.), and also of the binding effect of the Company's treaties. The principle of co-operation, and of the duty imposed upon rulers,

who are protected and safeguarded against annexation, to govern their States with justice, was announced at Delhi on November 1, 1858, in Her Majesty's Proclamation, and repeated by Lord Lytton, in 1877; and the century has witnessed the most cordial understanding between the Queen Empress and the protected States of India.

Now that I am compelled to bring my remarks to a close, I feel how much I have left untold; and in particular the administration of justice and of the finances, the capital sunk in reproductive public works, the conduct of famine campaigns, and the industrial and commercial development of the country deserve your study. But the Society has already published papers upon some of these topics, and in its programme for the current session others are included. Moreover, I have assumed that my hearers are familiar with the pages of the annual "Moral and Material Progress Report." I shall, therefore, conclude with a few general observations which may direct your thoughts to the question of the popularity and prospects of British rule. If any one who has taken part in Indian administration for a quarter of a century feels and expresses pride in the work of his country, he is often charged by dyspeptic critics with official or Anglo-Indian optimism. He is told that he is unable to see his work as others see it. But Indian officials are not exclusively dependent on their own perspective for a view of the situation. The native Press may be trusted to expose any failures and defects, imaginary or real, in our system, and of candid friends there is no lack. If we want to see ourselves as our enemies would paint us, the literature of the Mutiny gives us the opportunity. On March 22, 1857, Colonel Birch received a document which was found by an orderly of Major Mathews. It ran as follows:—"The Company has given orders to destroy the religion of the country. The salt department mixes bones with the salt. The officer in charge of the ghee mixes fat with it. The sahib in charge of the sugar burns up bones and mixes them in the syrup. Orders have been issued for all rajas, zemindars, and ryots to eat together. All classes of Hindus, on becoming widows, are to be married again. Therefore, we consider ourselves killed." But a far more reasoned document was the proclamation issued on September 15 by the royal army at Delhi to all its brethren, Hindu and Mohammedan, throughout India. It was written by Sheikh Saied Rungin Rakam, under direction of Kishori Lal, and it ran thus:—

"Three causes contributed to the succ of British rule:—(1st) They were true to th promises and engagements; (2nd) they much service by the construction of roa and earned the gratitude of travellers securing their safety; (3rd) in the admi tration of justice they showed no partiality members of their own race."

Then followed a long list of indictments which the main counts were as follows:—' Babu has collected 155,000 instances of th treachery up to 1848, and since then, th sands of other instances have occurre One instance of maladministration of just was recited:—"Mr. Gibb has received p mission to murder as many natives as pleases without being called to acco Ninety-three lakhs of rupees have been gran to him for expenses." Special paragra were devoted to our laws relating to wom to our educational system, and to our medi treatment of the sick. The appearance women in court was denounced, and of laws it was written that "regulations w made in order to give full liberty to wom thus subjecting every man to petticoat gove ment;" our schools for girls were descri as "schools of adultery," and our gene system of education as an organised attack u the Hindu and the Mohammedan religio In our hospitals it was asserted that "ma is performed by the preparation of herbs minerals, by the invocation of demons, and planetary influences, in all of which Satan versed." Finally our policy of annexation conquest was attacked in detail, and in so cases without much regard to historical fa and our national characteristics were descri as "pride, lust, bigotry, and dissipation."

We may stand with perfect confidence the bar of history, and take up the challe thrown down by the royal army at Delhi. have done nothing to lose the confidence wh the early action of the Company inspired as proclamation itself admits. The substitut of Lord Canning's Sanads of adoption for doctrine of lapse has, once and for all, remo the one occasion which furnished to our cri some grounds for imputing to us breach of fa Of our fidelity to our promises and engageme that signal mistake the Permanent Set ment, and the annals of the present cent afford abundant instances. In the construct of roads, canals, and public works of all so no other nation in the world has ever retur

the taxpayer so large a proportion of the enues. Our famine campaigns are waged h ungrudging liberality, and life and proty are as secure in India as in England. no other country in Asia, and of no other iod of Indian history can the same be said. Abbé Dubois, who lived for many years ongst the people at the close of last century, te :—"No man can be called in India the ster of his own wealth, however lawfully uired." Speaking of the industries of thern India, he added :—"As soon as it nown that an artist of great skill exists in district, he is immediately carried off to palace of the ruler, where he is shut up for , and compelled to toil without remission with little recompense." Tod wrote of the vali Range : —"The caste of miners is nct, and political reasons under the Mogul ninion led to the concealment of such rces of wealth." No one can now make a rapid tour in India without realising security and freedom which its people by. Then, again, if you would compare justice of to-day with that which was given the people by their own chiefs before our , I may again refer you to Dubois, whose tiality will not be suspected. "There is ning in India that resembles a Court of tice. Neither is there a shadow of public it, nor any code of laws by which those who minister justice are guided. The Brahman sildar is accountable only to the Prince. causes most eagerly taken up are debt fines. The fines go into the Judge's ket. When nothing is to be gained by ing cognisance of a case on an ordiy subject, the Judges, to save themselves ble, remit the matter to arbitrators." the Deccan, prior to British rule, Mountart Elphinstone wrote, "Justice was openly l, and except as a marketable commodity was never thought of." It is perfectly orious that impartial justice is now offered India to rich or poor, European or native. doubt the administration is hindered, as it all countries, by legal expenses and legal ns, and by the prevalence in India of per-, owing to which the guilty of all classes imes escape. But the fact remains that ish rule is founded upon the three foundas of good faith, material development of country, and impartial justice, and all that can do to strengthen those foundations is g done. We can honestly look the Delhi lamation in the face, and answer our sers in these respects.

At the same time it must be admitted that arguments and misstatements of fact, very much on the lines of the Delhi Proclamation, still find an audience in India, and they work a deal of mischief. Some of them we must continue to endure until the social and religious differences which divide the East from the West, aye, and one class or race of Indians from another, are mitigated by the forces of civilisation. No one dwells willingly on the essentially different standards of taste, truth, and morality which divide the East from the West, or on the gulf which Hindu ideas of eating and of caste interpose between man to man. So long as Indian society opposes Western ideas of right and duty to one's neighbour, our regulations for the protection of women's rights, our schools, and even our imported justice will be matters for complaint and misunderstanding. We must also make allowances for the infancy and the novelty to India of a free Press. India is the land of extremes, where fickle nature shows her power in deluging storms, sullen years of drought, or terrific earthquakes, and its inhabitants are apt to give torrential expression to passing emotions. But when all allowances have been made, the disappointing fact remains that too many of the native newspapers systematically adopt a tone of bitterness and hostility to the British Government. They not only publish false news, which is hastily embraced and passed on to the injury of the State, but they take in ill part and traduce the very acts and measures which ought to be received with gratitude.

It is easy to show cause why this hostility should not be viewed in too serious a light. The profession of an editor or a contributor to the Press is in India neither lucrative nor regarded as honourable. Those who have failed to obtain public patronage or situations in business turn to writing for the newspapers. To secure an audience, they appeal to passions and prejudices of caste or religious faction. At heart conservative, they have no sympathy with the liberal levelling principles of a foreign rule. Their opposition can be disarmed only by a surrender of our trust :—

> "'Tis but the fate of place, and the rough brake
> That virtue must go through."

The harm that the Press can do is discounted by the inability of the masses to read what they write; 942 persons out of every 1,000 in India have never learnt to read or write. The most liberal estimate of children receiving any sort of instruction is 12 per cent. Whatever malice or misrepresentation may publish, the readers

are a microscopic few. Finally, it must be remembered that, whereas in the Native States no newspaper dare attack its Government, in British India there is full liberty of the Press, subject only to the provisions of the Penal Code. In Mysore an editor lately forgot this difference, and his trade was immediately stopped. No stress can, therefore, be laid on the contrast of tone in the Native States; while the conspicuous loyalty of their rulers gives the best contradiction to the claim of the spiteful section of the Indian Press that it is the voice of India.

But whatever excuses may be made for it, the hostile attitude of the Indian Press must weigh heavily on the minds of those who wish well to India. We have spent much on education, and we have reduced the thin line of British civilians even below the barest necessities of control. We looked to reap a harvest of goodwill, mutual confidence, and sympathy. In handing over important posts in the public service to educated Indians, we hoped that we were drawing India and the United Kingdom closer together:—

"As climbing plant and propping tree."

Lord Macaulay pleaded for higher education in these terms:—"We must do our best to form a class who may be interpreters between us and the millions whom we govern; a class of persons Indian in blood and colour, but English in taste, in opinions, words and intellect." It must be confessed that the 19th century is sinking below the horizon without the full attainment of the results which Lord Macaulay expected. But we need not despair of the work which Providence has set before us. If the story which I have imperfectly told kindles a sense of pride in the work which our forefathers have accomplished, it will also, I hope, suggest humbler feelings of the magnitude and responsibility of the great inheritance entailed upon us. The various races of India are now a bundle of sticks fastened together by a common allegiance and a common citizenship of no mean country. Hindus, Mohammedans, Sikhs, Parsees, Buddhists, and Christians are well able together to uphold the fabric of the Indian Empire, built as it is upon the pillars of justice, good faith, and public peace. Each race has special qualities which it can contribute to the stability and prosperity of British rule; and if the clouds seem to roll up as the century goes down, we may gather hope and energy from the words of the greatest poet which it has given to us:—

"Are there thunders moaning in the distance?
Are there spectres moving in the darkness?
Trust the Hand of Life will lead her people
Till the thunders pass, the spectres vanish,
And the light is victor, and the darkness
Dawns into the jubilee of the ages."

DISCUSSION.

The CHAIRMAN said he understood that it was c tomary for the discussion which followed the read of these papers to be opened by the Chairm and in this instance an advantage might en from following that course, for he would endeav to set an example of brevity to succeeding speak He was sure they would all wish him to exp the satisfaction with which they had listened this most interesting paper read by Sir Willi Lee-Warner, for it must have been interesting everyone to trace the progress of our Inc fellow-subjects. From whatever source that p gress proceeded, whether from the spread knowledge or the discoveries of science, it must gratifying to know that the native subjects of Queen were progressing in prosperity and happin It was especially gratifying to find that that p gress was due to good government for which we home were mainly answerable. It was not su cient that the government should be good and wi they ought if possible to make the natives India believe that their prosperity and good gove ment was especially the care of the English nation. was very gratifying to him to read a speech of a m eloquent character delivered a few months ago b native physician of Bombay on the occasion of festivities attending the Queen's birthday. He told audience how great had been the progress of country during the past forty years, and t all that tended to the happiness and good gove ment of the country could be traced to one gr event which happened during Her Majest reign. He then referred to one of the m eloquent documents ever penned in the Ang Saxon language—the proclamation issued by Queen in 1858, when the nation undertook the m agement of Indian affairs, and when the rule of the East India Company passed away. One word as the history of that charter of liberty which was tl granted to the Indian native. Sir Theodore Mar the gifted historian of the life of the Prince Cons had told them, having special authority to do so, history of that document. It was not only personal policy dictated by the Queen, but a port of it was written by her own hand, and never wa more eloquent document written in a noble ca than that proclamation. They would recollect words where it commenced speaking to the Inc people, "In your prosperity is our strength; in y contentment is our security; and in your gratitud our best reward." The native gentleman to wh he had referred quoting these very words, as a mini

·eligion would quote a text, declared that the Indian ›ple knew that those words were true, and that that itentment and prosperity were the strength and urity of the British race, as well as of the Indian es. One very important feature of that proclama-n was the care then taken of the freedom of the tives' religious views, and he should like to read the ›rds which were sent forth to the Indian people in : very hand-writing of the Queen herself:—" Firmly ying ourselves on the truth of Christianity, and knowledging with gratitude the solace of religion, : disclaim alike the right and the desire to impose r convictions on any of our subjects. We declare to be our Royal will and pleasure that none be in ywise favoured, none molested or disquieted by ıson of their religious faith or observances, but that shall enjoy the equal and impartial protection of e law; and we do strictly charge and enjoin all ose who may be in authority under us that they ›stain from any interference with the religious belief worship of any of our subjects on pain of our ghest displeasure." Sir William Lee-Warner had ld them of different eras of advance in Indian pro-ess, but surely that document marked a new era—marked a line from which advance had been made, ıd he felt certain that Sir William would agree that ıring the last forty years, since the issue of that oclamation, there had ever been by every Govern-ent in this country the greatest desire to carry out ıe noble sentiments therein contained, and that, by ow degrees it might be, but still surely, it as coming about that the Indian native was eginning to believe that the promise of that procla-ıation had been fulfilled, and that the security of ood government and equality under the law had een assured. In conclusion, he would again express ıe thanks of the audience to Sir William Lee-Varner for introducing a subject so full of interest to veryone as the government of the Queen's subjects ı India—probably never of greater interest than at hat moment, when they knew that the safety of this ountry could be secured, and support could be ›btained for it in a moment of strain and stress only ›y winning the affections of the Queen's subjects in istant lands, and by bringing to them the certainty ›f freedom and security which must result from the ;ood government of the Empire.

Sir James Westland, K.C.S.I., said that his only laim to discuss this paper was that his persona xperience of India came down to a very recent date, s it was less than a year since he had quitted its hores, after taking some part in the direct administra-ion of the country. The subject dealt with in the paper was certainly very far-reaching, and the author ıad accomplished a very difficult task in managing to ompress within so short a time a description of the ›rogress made during the past hundred years. Throughout his paper there was only one subject on vhich he expressed a certain amount of regret, and in vhich he could not claim for the Indian Government the success which had attended it in other matters, and that was when he contemplated the results of our educational policy, and especially the development which had taken place arising out of that policy, in the Indian native Press. He believed that a better time was coming even in that respect, and that they might look forward to the time anticipated by Lord Macaulay, when they would, through their educational policy, have raised up a class which would, on the one hand, be the interpreters of our administration to our subjects, and, on the other hand, the interpreters of the wants of our subjects to the administration. As matters at present stood, he feared that we had failed in this object, and that the class which had been raised up was a class which had wants and ambitions which were never the same as, and were sometimes inconsistent with, the progress and prosperity of the vast mass of the people. The efforts and sympathies of English officers in India would always be exercised in favour of the vast toiling millions whose one object was to have their life and property secure, and who passed year after year in doing, according to their lights, their duty by their neighbour, and their duty by their gods. It was, perhaps, from a Western point of view, a low type of life, but it was a standard which pleased them, and if the efforts of our administration were to be directed to the prosperity and comfort of these classes there was a great deal yet to be done which might be obnoxious to the criticisms of the higher class, represented by the native Press. As they had heard in the paper, the profession of journalism was not one which was held in very high honour in India outside the Presidency towns. About two years ago the Government was considering the question of the postal rates which for many years in India had been lower even than in England. They were then discussing the possibility of still further reducing them, and one of the proposals affected the native newspapers. It was proposed to increase the weight of a newspaper which could be sent by post at the lowest rate of postage, but, at the same time, to withhold the privilege, which had been considerably abused, of allowing native newspapers to send what they called "exchange copies" free of any postage whatever. The result was that they got a memorial from a large number of gentlemen in Bombay, who described themselves as editors of native newspapers, and their remonstrances amounted to this:—They had passed through an educational curriculum, they failed to obtain employment under the Government, and what was there for them to do except to start newspapers of their own and sell them? They went on to point out that they could not do this unless they got exchange copies of all the other newspapers printed and published under similar circumstances, and it would be very hard on them if these native newspapers ceased to be carried at the public expense. He remembered thinking when he read that that the practice of journalism, which had developed in that part of India, was very similar to

the state of things once described as existing in an English village, where all the residents made a living by taking in each other's washing. The memorial was not received very sympathetically, and, at any rate, they did not adopt its recommendations. There was one part of the paper in which he was not able to agree with the view stated, namely, that in which the author described the French adventurers who took service under various detached portions of the Mahratta Empire at the beginning of the century, and assumed that they were a continuance of the French influence such as it existed in the earlier part of the 18th century. He did not think that they could legitimately father on the French Government the actions of those French adventurers. It was not foreign to the practice either of the French or other Governments to allow their subjects to engage in adventures of that kind, at first on an independent footing, and afterwards if they were successful, to step in and take advantage of them, and he did not by any means say that if those men had been successful in their action it would not have led to the exercise of a strong French influence against the British. He presumed that most of those present had read something about the struggles of the French in India, which were certainly very nearly successful, and, in fact, it was more a matter of good luck than of good management that a French empire was not established in Southern India in such circumstances as would have excluded the British altogether. We had no one equal to the two French generals Lally and Dupleix, who administered a considerable part of Southern India during the period from 1730 to 1750, and if they had been properly supported by the home administration he feared there would have been a French empire in that part of the world instead of an English. But certainly the French influence, the only serious one against which we had to contend, was wiped out before 1753. After that, the only dominant foreign influence was that of the English. From before the beginning of the 19th century we had been practically free from any rivalry on the part of European nations, and had had a free course, our struggles to maintain our empire being uninterrupted by any European rivalry. It was rather amusing to contrast the position once held by the French with that which they now occupied in India, almost their only possessions now being Pondicherry, which he did not know much of, as he had never been there, and Chandernagore, a little place to which people sometimes made a pleasant day's trip from Calcutta by steamer. It lay on the banks of the Hugli, and was rather a dead-alive place, and its quietness and sleepiness contrasted very strongly with the bustling activity of the cities in English India. A treaty existed under which these two settlements, Pondicherry and Chandernagore, were held by the French, and there was something amusing in the indifference with which the English at the time contemplated the maintenance in French hands of these small territories. There was a provision that the French should not maintain any soldiers there and some others to prevent their dev loping any strength, but they did not even define t bonndaries of the settlement. The last clause of t treaty relating to Chandernagore, really assumed th that was a matter not worth settling. It said th the English regarded the boundary as the water li of the river side, but the French contended it shou be as far out in the river as it took to anchor a count boat, but it was not decided which it should be. T chief use to which this place was put during his tir was as a refuge for people who could not pay th debts, and wished to escape the process of the Ci Courts in British India. He knew one gentleman, wh was apparently afraid of the process, both of th French Courts and of the English, and he was fort nately able to find a house which lay exactly on th boundary, being half in English and half in Frenc territory, so that when the bailiffs of the Englis Court made their appearance he had only to go int the French half of the house, and if the French bailif came he returned to the English half, and thus secure immunity from each, as it did not appear that the tw sets of officers could make arrangements to both go a the same time. With regard to the military force of Chandernagore, a short time ago, ther was a story in Calcutta, that the Frenc Government had been importing uniforms an accoutrements for its soldiery, and he be lieved that was true; but he could not vouch for th remainder of the story, which was that the total amoun introduced was only a uniform for one man, the in tention being that this uniform should be utilised fo the whole army, passing from the man who left duty to the one who succeeded him. This place was als utilised for the establishment of factories even by th English, because it was free from the English factory legislation. He remembered a case where certai merchants of Calcutta desired to establish a factory there on this basis, but they found on inquiry tha there was another provision of the law which wa not so convenient, namely, that as the factory woul be in foreign territory, every piece of manufacture goods which came from it would have to pay import duty; and on discovering that they changed thei minds. These two places were now pretty nearly all that remained to the French of what might at one time have been a French empire in India. The French were very courteous in all their dealings with the Government of India, and never attempted, as they might easily have done, to make these places a thorn in the side of the British Administration. There was one expression in the paper which always tended to put his back up, and which represented a theory which he knew prevailed over a great part of India, but which he, as a Bengali, could not adopt; he referred to the phrase that the Permanent Settlement of Bengal was a "signal blunder." Sir William took this for granted, and he (Sir James Westland) knew the notion prevailed in Bombay. He was not going to discuss it, though a great deal might be said

ıvour of the Permanent Settlement; but he would ply say that, because it would be a ridiculous take now to make a permanent settlement in nbay, it did not necessarily follow that it was a nder to make one a hundred years ago in Bengal. ıust not be forgotten in what a miserable position were in India at the opening of the century. ›king at the map now they saw that the British ıinions extended over the whole Peninsula of ia, and even took in Burma; but when the rquis of Wellesley went out, a year before the ıtury began, Bombay—now, industrially, the most anced part of India — was confined to the nd, and no part of the country more than thirty es from it was under our dominion. Madras s a scanty territory scattered along our coast; it s only two or three years afterwards, under rd Wellesley, that they took possession of the rnatic. In Bengal, their territory ran up north far as the boundary of what is now known as lower provinces of Bengal. Beyond that the coun- was held by the Nawab of Oude, the latest sur- or of the old Mogul empire. We were hemmed on all sides by native princes and by the ıhratta empire, which not only possessed practically whole of the present Bombay Presidency, but ran oss India and debouched on the Bay of Bengal; fact, the English dominion was only one small gment in the midst of bigger fragments. Within e years Lord Wellesley added enormously to it. In first place the Mahratta empire was scattered, the ıfederacy was beaten in war, and its territories were ded to the Bombay Presidency, and made it some- ng like what it was now. In the north the Nawab Oude was made to surrender his dominions, and so e North-West Provinces were added. Where did e money for all these operations come from? It was e permanent settlement of Bengal which gave Lord ellesley the funds to do this and to lay the foun- tion of India as it at present stands. One thing that ›rd Wellesley did was to build a magnificent Govern- ent House in Calcutta, which was still considered a itable residence for the Viceroy, and the grand ıtertainment to which reference had been made the paper was not merely in honour of the eace of Amiens, but was also the house-warming the Government-house, it being the first time hen the Governor-General entered into occupation. here was something very noticeable in the mar- llous foresight of Lord Wellesley. At that time, ritish India was, as he (the speaker) had de- ibed it, as small territory, and it was a strong easure for a statesman at that time to look for- ırd to England obtaining in India a position of edominant power unchallenged over the whole eninsula. It was because Lord Wellesley looked rward to that position that he was able to y the foundation of it in the treaties he made ith various native States, and similar consider- ions led him to build what he considered a itable palace from which the affairs of the India he contemplated could be administered instead of from a mere office table.

Mr. H. M. Birdwood, C.S.I., said that the subject of Sir W. Lee-Warner's paper was very wide, and suggested many different methods of treatment, so that the difficulty of dealing with it adequately within the short space of one hour would be readily appreciated; but those who had listened with pleasure, as all present had done, to his admirable exposition of the events of Indian history, and of the administrative measures of the British Government, which stood out prominently in the retrospect of the century now drawing to a close, would agree with the Chairman that Sir W. Lee-Warner had discharged his task most effectively. He wished to address himself mainly to a single topic, as to which Sir W. Lee-Warner seemed to him to have taken a rather despondent view towards the close of his paper. No doubt, some of the apparent results of our educational policy in India had brought us disappointment; but there was, in his opinion, no ground for any serious misgiving as to the soundness of the policy which, in the very year in which India was shaken by the Mutiny, had decreed the establishment of universities, on an English model, at the great Presidency towns, for "the better encouragement of Her Majesty's subjects of all classes and denominations in the pursuit of a regular and liberal course of education." In matters relating to education, we then determined to give India of our best, with a free hand, and without fear of any possible consequences. The adoption or such a policy at such a time was generous. Anyway, it was thoroughly English; and the good which it had produced was quite appreciable, and far outweighed the evil. This was not a sentimental view, but was based on personal observation extending over a long period, and reaching back to the time when the universities actually started work. He was an examiner at the first matriculation examination held by the University of Bombay, in 1859; and had taken part in subsequent examinations, at intervals, during a period of ten years. He had, moreover, taken part in the government of the University, as a member of the Senate, as a Syndic, as a Dean in Arts, and as Vice-Chancellor; and had watched with keen interest the marvellous expansion of educational effort in India during the past forty years. As a member of the Indian Civil Service, he had also had ample opportunity of estimating the effect of our educational policy on the efficiency and tone of the public service. And he had no hesitation in saying that, as regards those branches of the public service with which he himself had been concerned,—in which educational qualifications were essential,—there had been a distinct and most satisfactory advance during the past forty years, both as regards the professional qualifications and the character of members of the public service. He was speaking more particularly of the Judicial branch of the service,—of the in-

digenous Judges, trained and recruited in India,—the Subordinate Judges, and Judges of Courts of Small Causes, belonging to the Provincial Civil Service, who presided in the Courts of First Instance, and dealt with the great mass of original litigation throughout the country. No doubt the improvement in this branch of the service was due to a combination of causes, including the provision by the Government of adequate salaries, and the careful and continuous supervision of the work of the Subordinate Courts by the Judges of the Superior Courts. But it was also possible only because we had provided the requisite educational machinery for properly equipping candidates for the public service for their work. No doubt there were defects in our system. We had not, for instance, in the Bombay Presidency at all events, succeeded in bringing the Mohammedan community into line with our general educational policy, with the result, deplorable from any point of view, that the members of this important community had, as a rule, failed to qualify themselves for certain branches of the public service, from which they were thus practically excluded. Again, cases had occurred of men who had passed through our schools and colleges, and yet had not been humanised by the process, but had remained barbarians still, with all the mischievous propensities of the semi-civilised. But there are barbarians in civilised communities, and even in learned institutions, much nearer home; and no untoward developments should obscure for us the essential truth that the Indian Universities are an integral part of our Imperial system. They are not themselves teaching institutions, but, by prescribing the subjects for examinations for degrees in the various Faculties of Arts and Law and Medicine and Civil Engineering, they necessarily influence the course of studies in all teaching institutions, whether under public or private control; and it must be assumed that one of the objects of the Government of India, in thus making provision for higher education, was to ensure a due supply of indigenous officers, qualified to take their part in the work of all departments of the public administration with the members of the Imperial Civil Service, which is recruited in England, though it is open to all natural-born subjects of the Queen, from whatever part of the Empire they may come. Effect has thus been given to the intention of her Majesty's gracious proclamation of 1858, to which the Chairman had referred, and a staff of officers, constituting the great Provincial Civil Service of India, had been raised up, large numbers of whom had been prepared by a course of liberal education, in the English sense, to appreciate and assimilate our principles and methods of administration, and to actively assist "so far as may be" (as contemplated in the proclamation) in the duties of good government. And, if time permitted, it would be possible to cite many instances to show that, not only had the requirements of the liberal professions been met through the agency of our educational institutions, but that the co-operation of educated Indian officers had been of the highest value to British Government, not only in the Judicial bra of the public service, to which reference had alre been made. but also in the departments Revenue, Education, and Public Works, and those departments which deal with medical affa the administration of hospitals and dispensa and public sanitation, in all of which educa Indians had rendered efficient and loyal servi and, in some conspicuous instances, brilliant serv of a high order. Indeed, as pointed out Sir W. Lee-Warner, the great majority of C officers are necessarily and always have been nati of India, though the fact is sometimes lost sight We might, therefore, well be proud, as a nation, of work in India during the 19th century, of wh Sir W. Lee-Warner had so eloquently spoken. conclusion, he (Mr. Birdwood) desired to express entire concurrence with Sir W. Lee-Warner as to t necessity for maintaining the Imperial Civil Serv at such a standard of numerical strength as sho suffice for all purposes of control and for all otl duties that devolved upon it. The higher admin trative requirements of an area, exclusive of th of the feudatory States, comprising nearly 965,0 square miles, or nearly eight times that of the Briti Isles, and of a population of 221 millions, or nea six times that of the British Isles, were provided by about 1,000 officers only of the Imperial Ci Service, and the demands made on this small bo for executive duties during recent years of plague a famine had, in the Bombay Presidency at all event made it a matter of extreme difficulty for the Gover ment to provide a sufficient staff of Judges for t ordinary work of the District Courts. The Imperi Service needed strengthening, even for its ordina duties, and much more so at the present time exceptional stress and strain. The duties devolvi on its members were of special importance, on t right performance of which the safety and progress the Empire largely depend, and it was a matter Imperial concern that it should at all times be strong service, both as to numbers and quality. T best of our British graduates would always find India work worthy of their noblest ambition.

Sir WILLIAM LEE-WARNER, in reply, observe that he was not sure, from the tone of Mr. Birdwood remarks, whether Mr. Birdwood had quite caught th terms or the spirit of the references made to educatio When, however, the paper appeared in the *Journa* he would see that the speaker relied upon educatio to teach our Indian fellow-subjects to take the proper and honourable part in bearing up the empir and in the administration of its affairs. Educatio had done much, but, as was pointed out, it had n yet done all that Lord Macaulay had expected. S far from desiring less educational effort, he (S William) desired more in quantity, quality, variety and depth. We wanted far wider education of th masses, and more care in bringing on the backwar

s, and educating for the public service repre-tives of all castes and classes of the community. s probably in part due to our educational system ur schemes of public patronage that in Bombay Iohammedans and the Mahrattas had not quali-hemselves so fully for the public service as fortunate castes or classes had done. As ds the criticisms of Sir James Westland, was force and truth in the caution that the ch adventurers mentioned in the paper were not gents of the French nation. No doubt most of were working for their own hands, but history ed that nations reaped the profit of the enterprise adventure of their sons; and we must remember some of the Company's acquisitions were won by dventure of individuals, and in the days of Com-es the interval between the successes of adven-us individuals and national successes was small. speaker, therefore, justified his references to the itions and aims of Perron, Bourquin, Ventura, others, as measures for the advancement of ch influence, which were of serious danger to the ility of our empire, and which our ancestors had ombat in the early part of this century. Sir James stland had referred to his expression, the "signal take of the Permanent Settlement" as due to some nbay prejudice. He could not admit this soft im-chment. He had sufficient respect for his audience, was now old enough, to submit for their con-ration not one but all parts of his experiences, if value might be claimed for them. He addressed audience not as a Rugby, or a Cambridge, or a nbay, or a Mysore speaker. In his reference to permanent settlement he actually had in view a e of Bishop Heber's account of his tour, which lying before him when he wrote that sentence. hop Heber, who was travelling in Bengal, and in se conference with the most distinguished of ngal officials, recorded the observation that it was v generally admitted in Bengal that the famous asure of Mr. Law was taken on an imperfect juaintance with the interests of India. That, the aker believed, was a true proposition. Finally, in nking the noble Chairman for the kind and appre-tive remarks which had fallen from him, and audience for their kind attention, he observed it the noble and eloquent proclamation of Her ijesty was viewed not merely as the great Charter Rights of the people of India, but as the epitome public duties, and the Sovereign's commands to servants in India. He had not treated the Pro-mation as making the year of its issue an epoch the century, because the document represented all it was best in the fifty years of Indian administra-n that preceded it, while it marked out in its ong and high-toned directions the goal for the ure. It rather expressed the spirit of the century in constituted a new departure. It was a paper ich every civil servant knew by heart, and which istituted his chart when he entered upon his career Her Majesty's Indian Service.

NINTH ORDINARY MEETING.

Wednesday, January 31, 1900; MAJOR LEONARD DARWIN, R.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Birnbaum, Henry B., 3B, Cannon-street, E.C.
Crush, Ernest Hope, 17, Foyle-road, Blackheath, S.E.
Darwin, Major Leonard, R.E., 12, Egerton-place, S.W.
Glass, James George Henry, C.I.E., Tamworth, Mitcham, Surrey.
Greener, C. E., Strelna, Chester-road, Erdington, near Birmingham.
Stocken, Alfred Leonard, Mazères sur le Salat, Haute Garonne, France.
Whitehead, Thomas Ross, Lythalls-lane, Foleshill, Coventry.
Wiener, Louis, 1A Fore-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Aberdare, Lord, Duffryn, Aberdare.
Arden, Edwin Cooper, Liddel-bank, Canobie, Dumfries-shire.
Bliss, Sir Henry William, K.C.I.E., 13, Chesham-street, S.W.
Brophy, Prof. A. Finn, Technical-college, Leonard-street, E.C.
Caird, Captain Lindsay Henryson, Woodbourne, Bushmead-avenue, Bedford.
Carter, His Excellency Sir Gilbert Thomas, K.C.M.G., Government-house, Nassau, Bahamas.
Charlton, William, J.P., Egerton-bank, Higher Openshaw, Manchester.
Cockerell, Douglas, 6 Denmark-street, W.C.
Couper, James, 22, Aislibie-road, Lee, Kent.
Edwards, William Rowland, Rosedale, Weybridge.
Farmer, Charles, 12, Wood-street, E.C.
Jackson, William Frederick, Mount-view, Sheffield.
Krause, R. Howard, I. Ebendorferstrasse, No. 10, Vienna.
Lawrence, Joseph, Oaklands, Kenley, Surrey.
Molloy, Ambrose James, Bangalore, India, and care of Messrs. Grindlay and Co., Parliament-street, S.W.
Parkinson, J., Canal Ironworks, Shipley, Yorks.
Phillips, Joseph, 30, Hart-street, Altrincham.
Ridge, Joseph, Tudor Works, Sheffield.
Robins, Joseph George, 84, Trinity-road, Wood-green, N.
Shippard, Sir Sidney Godolphin Alexander, K.C.M.G., D.C.L., M.A., 15, West Halkin-street, S.W.
Thomson, Alexander, Widmore-house, Bromley, Kent, and 27, Mincing-lane, E.C.
Upcher, Henry Morris, J.P., Sheringham-hall, Cromer, Norfolk.
Wagle, Nilkanth B., B.A., 28, Castletown-road, West Kensington, W.
Wallace, Charles William, 6, Langford-place, St. John's-wood, N.W.

The paper read was on—

SOME OF THE UNDEVELOPED RESOURCES OF BOLIVIA.

By Sir Martin Conway.

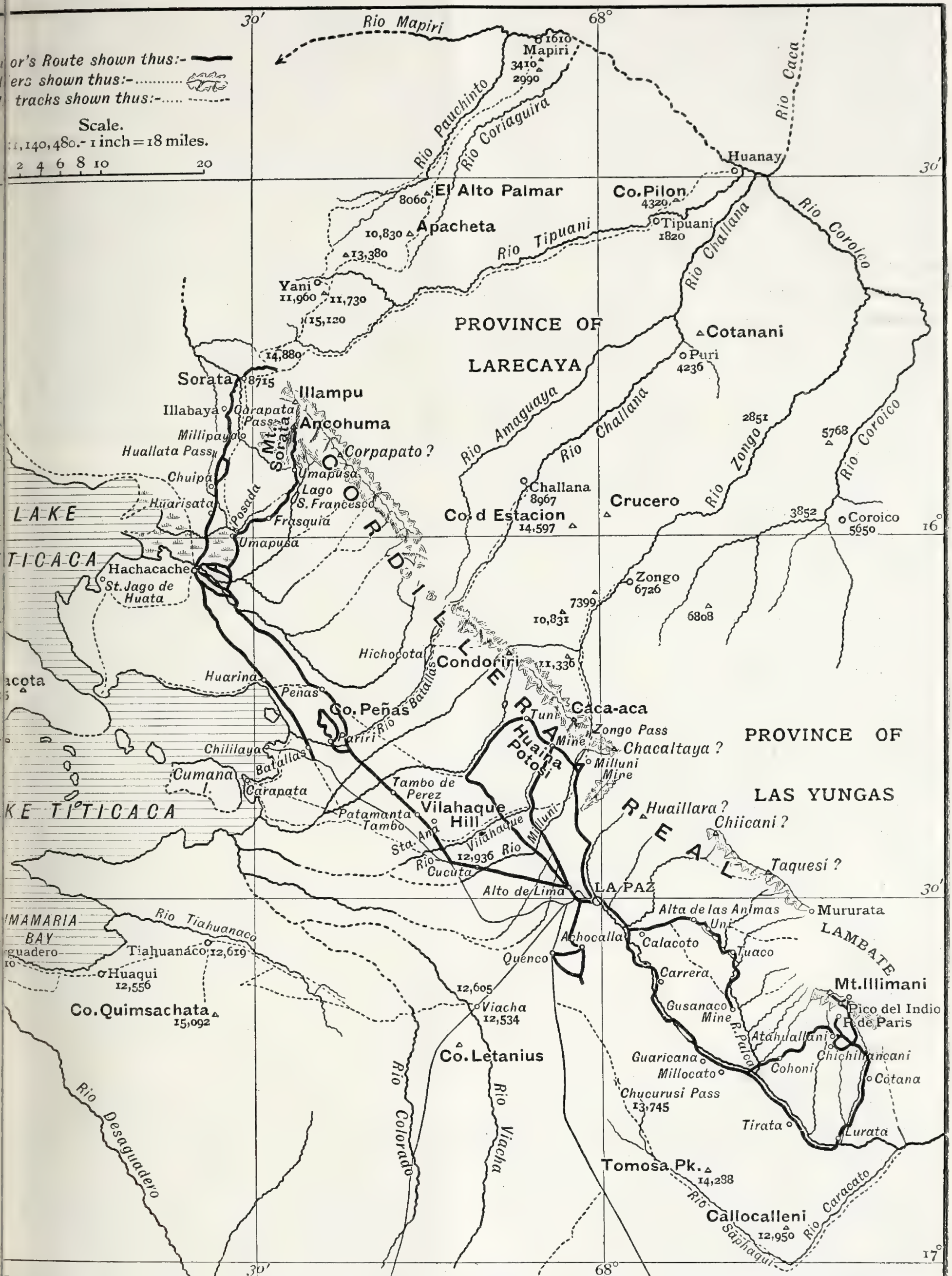
Bolivia is an entirely inland country, the Switzerland of South America. It lies mainly between 10° and 22° S. lat. Geographically it may be divided into three parts—(1) the high plateau from 10,000 to 13,000 feet above sea level; (2) the high valleys from 3,000 to 10,000 feet above sea level; and (3) the lower slopes and the plain from 3,000 feet downwards. The high plateau lies between very lofty ranges of snowy mountains. The plateau produces potatoes and barley. The high valleys yield cocoa, coffee, coca, maize, sugar, and fruits. The lower slopes and plains are occupied for the most part by a dense and largely unexplored forest, rich in india-rubber and other tropical produce. The population of the country is not exactly known. It is estimated at 250,000 whites, 50,000 half-breeds, 1,000,000 Indians within the influences of civilisation, and a much smaller number of wild Indians dwelling in the forests.

Bolivia is surrounded by Peru, Brazil, Chile, and Argentina, and is approached by five main routes:—(1) From the Peruvian port of Mollendo, by railway past Arequipa to Puno on Lake Titicaca; thence by steamer to the Bolivian port of Chililaya, whence a high road leads southwards over the plateau to La Paz, and a mule path goes eastward over the Cordillera Real to Sorata and thence over other high and difficult passes to valleys tributary to the Rio Beni. (2) From the Chilian port of Antofagasta by railway through the southern desert to Oruro. Roads and tracks lead eastward from this railway to Potosi, Sucre, and Cochabamba. From Oruro a high road leads northward past Sicasica to La Paz. (3) From the Argentine railway system through Salta and Jujuy, and thence by road through mountains to Potosi and Oruro. Less used routes are (4) from Arica by a short railroad to Tacna and thence by a toilsome mule-track over the outer Cordilleras to the plateau of La Paz; and (5) by the Amazon and the Rio Madera and Rio Marmoré and Beni. This last route is only employed for sending out india-rubber. It is capable of development as a waterway, if a railway or a good road were made by which the cataracts of the Madera could be turned, and is the natural and almost only possible route for the export of the undeve[loped] wealth of the northern and north-ea[stern] forests. The Mollendo railway will al[so] control the export of the products of [the] western slope of the snowy range and [its] valleys, that are exploited from Sorata. [The] Antofagasta railway is the only line of e[xport] for the mineral products of the western si[de of] the Cordillera, south of La Paz. The Ar[gen]tine railway system, if it were extended n[orth]ward into the mountains, would control the south-east region. Thus the tropical fores[ts of] Bolivia look towards Brazil; the district n[orth] of La Paz and west of the Cordillera tow[ards] Peru; those south of La Paz and west of [the] Cordillera towards Chile; and all the s[outh] region east of the Cordillera towards [the] Argentine. The interests and character [of] these four districts are diverse, and t[heir] development is likely to be independent on[e of] another.

During the months of August to Novem[ber,] 1898, I was in Bolivia surveying and explo[ring] the range of the Cordillera Real and [the] adjacent regions. The object of my jour[ney] was purely scientific, and I was most kin[dly] received by the people and Government [of] Bolivia. I was thus placed in an exception[ally] good position to obtain information about [the] country and its resources, as well as about [the] attitude of the leading men towards foreign [capital] and foreign enterprise. It was evident t[hat] men of all political parties were desirous [of] attracting foreign capital to Bolivia, a land [of] boundless, undeveloped resources, which lo[cal] capital cannot avail to open up. Its min[es,] its forests, its communications, all are u[n]developed. Gold, silver, copper, tin, a[n]timony, and all other metals exist in profusi[on] in its mountains and river valleys. There i[s a] large Indian population whose rate of wages [is] absurdly low. Security for property is goo[d.] Thus large silver mines at Huanchaca a[nd] Oruro have been worked for many years [by] English companies at a great profit witho[ut] impediment from the Government, which h[as] never manifested any inclination to confisca[te] by fiscal injustice the results of commerc[ial] enterprise.

Some trouble has at times been experienc[ed] in respect of the titles to property. This is n[ot] owing to the law, but to actual doubts abo[ut] who the owner of the title may be. Differe[nt] prospectors or their heirs possess, or thi[nk] themselves to possess, overlapping claim[s,] especially to mining properties in uninhabit[ed] regions, and the disputes thence arising le[a]

[in]terminable lawsuits which paralyse in[dustr]y. Thus, in practice, the establishment [of a] good title may often prove costly. Lands [in] dispute till some wealthy individual or corporation buys them from the apparent owner and spends money on their development. But



Walker & Boutall sc.

THE CORDILLERA REAL AND ADJACENT COUNTRY OF BOLIVIA.

[This map has been prepared from materials kindly provided by the Royal Geographical Society.]

[c]laims in old occupation but now unworked [or] little worked, are liable to have doubtful [titl]es, which, however, it is no one's interest to land, such as the rubber forests, to which I shall presently refer at length, which have never passed out of the public domain into

private ownership at all till quite recently, and under the provisions of Acts of the Legislature, are now owned by an indefeasible title, which no one attempts to dispute. It is only since 1878 or thereabout that the existence of rubber in the eastern forest region has been known. Legislation was passed in consequence of the discovery, defining the manner in which these lands may be acquired. A small annual rate per *estrada* must be paid to the Government, and the lands taken up must be registered with a map of the area. The annual rent may at any time be commuted at a fixed rate, after which commutation the land becomes the freehold property of the purchaser. If the annual instalments are not paid the land lapses to the Government. Thus the Mollendo rubber forests ought now to be owned on an indefeasible title, and many of them are so owned. The titles of others are defective, either because there has been irregularity in the payment of rent, or from mis-description in the deeds of registration. The map accompanying the register often includes a very much larger number of *estradas* than the claimant has scheduled or paid for; and this of necessity, for no one can count or correctly estimate the number of *estradas* in an area which has not been explored in detail. Again, the maps themselves are inaccurately surveyed. Thus a multitude of questions may be made subject of dispute. In other cases, I am told, persons have obtained legal possession of a number of *estradas*, patched about, and now claim to own all the land included between those *estradas*. The question of title is therefore one that in any particular case needs close investigation on the spot. Up to the present time, however, none of these titles have been contested, and it does not appear to be the interest of any individual to contest them, whilst the chief interest of the Government is to induce men of capital to work the forests, introduce immigrants, develop lines of communication, and so increase the general trade and prosperity of the country. It is not likely, therefore, that the Government will attempt to upset titles even if they are not absolutely satisfactory, provided that the forests in question are properly worked.

I can only speak briefly of the mineral wealth of Bolivia. The country is as rich in this respect as any region in the whole world. It contains gold, tin, copper, silver, antimony, bismuth, borax, and manganese in paying quantities. Gold has been washed out of its alluvial gravels, especially in the eastern valleys of the Cordillera Real, since th[e] [re]motest times, and no appreciable inroad [has] been made on the almost exhaustless su[pply]. There are also auriferous alluvial deposi[ts in] the upper branches of the valley of the La [Paz] river, and veins of auriferous quartz have [been] located in the Araca mountain, over ag[ainst] Illimani, and are being profitably worked. [The] richest gravels appear to be in valleys ra[diat]ing from Mount Sorata, eastward or northw[ard]. American companies have been formed to [work] some of these, and another American com[pany] is working a mine in a side valley from th[e La] Paz valley, whose gravels appear to have [been] brought down from the flanks of Mount M[uru]rata. It is believed that mother-lodes exi[st in] Mounts Sorata, Mururata, and, perhaps, [Illi]mani, but a great deal of prospecting need[s to] be done, and it is a very difficult kind of w[ork] in such rough, mountainous, and practic[ally] uninhabited regions.

Silver mining is another of the hist[oric] industries of Bolivia. It is enough to men[tion] the famous name of Potosi to recal the fabu[lous] wealth drawn by Spain from this country. [The] Huanchaca Company's annual export of sil[ver], chiefly drawn from the now flooded Pulac[ayo] mine, was about 8,000,000 ozs. for the ye[ars] 1892 to 1897. The mines of Colquechaco [and] Oruro produce about 3,000,000 ozs. a ye[ar]. The total estimated output of silver in 1[...] was 10,000,000 ozs. There are many kno[wn] silver deposits which are little if at all work[ed] owing to lack of transport, difficulty of org[an]ising labour, &c. Thus at Sicasica are v[ery] rich deposits which cannot be worked o[n a] large scale until the Oruro railway is extend[ed], as it easily might be, to that place.

Copper is extensively mined at seve[ral] places, the most important being Coroco[ro], where four or five companies are profita[bly] engaged, but cost of carriage hinders [the] growth of the output.

Tin mining is being steadily develop[ed], especially in the Uyuni district, the rec[ent] high price of the metal having stimulated p[ro]duction. An important vein of tin, of gr[eat] thickness and very steep dip, cuts through t[he] foot-hills adjacent to Mount Cacaaca, and [is] being worked by a French company.

Borax, bismuth, antimony, and oth[er] minerals are hardly worked at all, though t[he] borax industry has received an impetus fr[om] the recent investment of German capital.

I have thus briefly dealt with the minin[g] industries and prospects of Bolivia. I no[w] turn to its vegetable resources. Time fails m[e]

speak of the coffee, cocoa, and coca tations, of the sugar estates, and the vine- ls. I can only deal very briefly with the a-rubber forests. In the great eastern n and low hills that flank the Rio Beni, still more in the little explored districts to north and north-east, are immense rubber sts, whose exploitation on any large scale or the future. It cannot be undertaken itably until the route to the Amazon is ned up and made easy. Some rubber goes way, but the difficulties and distances are great. That the day for this region come may be prophesied confidently, for enormous and ever increasing demand rubber made by modern electrical and other istries, renders the development of in- ised sources of supply a very important ter. From a recently issued United States isular Report on the Resources and Trade portunities of the Amazon Valley, I quote following important passage :—

I have learned that some accounts which have n written concerning rubber, although not entirely leading, have not been quite accurate. The ression created by the narratives of previous ellers who have been up the Amazon is that the ber production is on a constant and endless ease. It is not generally believed, but it is never- less a fact, that the output is not likely to increase ny marked degree unless a much larger force of ber gatherers is sent into the forests than has been ployed during the past year or two. This is the nion of the best informed rubber-plantation ners. Reports that the supply of rubber trees is xhaustible are largely overdrawn. It is true that ere is no fear of immediate scarcity of rubber, and rhaps there will not be for the next 50 years. It is lieved in well-informed circles that hereafter there ll be a gradual but steady shrinkage in the rubber oduct, unless the present force of rubber gatherers largely increased, because, in the first place, the es conveniently located near the banks of the rivers naturally the first to be worked, and in conse- ence are becoming exhausted from constant tapping, e milk extracted being weaker each year ; hence the inkage in such rubber is very great. In the second ce, the rivers have all been worked inland for a stance of about three miles from their banks, and, order to reach the so-called unexplored rubber ests still further inland, it will require much more ne and necessitate three times as strong a force. wners of rubber farms inform me that milk drawn m rubber trees five years ago possessed twice the ength contained in that extracted from the same e to-day. The islands near Para are all over- rked. Good judges can easily recognise rubber awn from overworked trees by its peculiar colour."

If, therefore, the supply of Para rubber does not show signs of increase, the importance of developing other sources of supply becomes obvious. The following observations upon the forests of so-called Mollendo rubber are the result of my own observations and enquiries, in which I was much helped by Mr. M. Martindale, an English gentleman, whose acquaintance I made in La Paz, and whose long experience of the country was unreservedly placed at my disposal. I have recently heard of his tragic death. He was killed by the fall of a tree in the Mapiri forest.

In the European markets a certain brand of india-rubber is sold under the name of Mollendo rubber. Of course no rubber trees grow at or anywhere near the Peruvian port of Mollendo on the Pacific coast. The name applies merely to the rubber which is shipped from that port. All the Mollendo rubber comes from the Bolivian province of Larecaja, the forest-clad valleys of Mapiri, Tipuani, Coroico, Challana, Zongo, &c., which descend north - eastward from the Bolivian Cordillera Real. The rubber is brought over various passes to the Bolivian Puna, shipped from Chililaya on Lake Titicaca by steamer to the Peruvian port Puno, and carried down by the Arequipa railroad to Mollendo. All Mollendo rubber comes from the valleys above mentioned, and all the rubber produced in those valleys is exported through Mollendo. The statistics of the rubber exported from Mollendo thus form an impartial record of the production of the Cordillera valleys.

The following are the statistics of the Mollendo rubber exports for a series of years :—

	lbs.
1893-4	37,587
1894-5	80,734
1895-6	251,341
1896-7	292,121
1897-8	491,087

The statistics of the year 1898-9 have not come to my hands, but the output was very much larger than in the preceding year, and the industry is gradually developing. The quality of Mollendo rubber, as judged by its price, is nearly equal to that of Para rubber, which is the best in the world. In the year 1898, Para rubber in the English market varied in price per pound from 3s. 5¾d. to 4s. 4½d., whilst Mollendo rubber varied from 3s. 4d. to 4s. 1½d. Considering the importance of india-rubber at the present time, it appears likely that some account of this little known forest region may be of general interest.

It must be borne in mind that the area under discussion does not include the Rio Beni and the region of the plains about it. The rubber that comes from the Beni is carried away to the eastward, and emerges into the light of commerce as Para rubber. It is only the forests of the lowest eastward Cordillera slopes that are comprised in the Mollendo district. The rubber trees there are stated to be of the *Siphonia elastica*, a large forest tree, approximately as big as an average English elm. These trees are self-planted. They grow in clumps, or *estradas*, of from 100 to 150 together, and these clumps rise well above the other forest trees, and can be seen from afar, so that the richness of any area can be judged by a general oversight from a commanding position.

In most parts of the world rubber-producing trees grow in a swamp, a condition which renders rubber forests direfully inimical to human habitation. In this respect the Mollendo rubber forest is a fortunate exception, for by all accounts it is not unhealthy; so, at all events, I was informed by an Irishman and a German, both of whom had spent the best part of from ten to twenty years in the forest. There are, of course, unhealthy places, but the forest is not generally unhealthy. The reason is that the trees do not grow on level swamps, but on the sloping sides of deep valleys or *quebradas*. For moisture they depend upon the almost constant cloud that hangs over them, and is formed by the cold air pouring continually down from the adjacent snowy Cordillera. This cloud is a geographical feature, and its lower limit appears to be the exact boundary of the Mollendo rubber forest. The upper boundary is a contour line at approximately the 3,000 feet level, above which altitude the tree will not grow.

The main valleys in the rubber zone are traversed by navigable rivers. The difficulty of transport begins at the upper limit of navigation, whence the rubber has to be carried by toilsome tracks over the high passes of the Cordillera. At present there are no roads and no mule-paths worth mention. There are a few tracks traversable by mules with difficulty. The best are the Mapiri and Tipuani trails which converge on the town of Sorata after surmounting passes of 16,000 feet altitude. The part of the forest which has thus far been best opened out is the area worked by these trails. Up to the present, therefore, Sorata has been the chief centre of the industry. The Challana and Zongo forests will not be properly worked till better tracks have been mad[e] the two passes north and south of [...] Condoriri and down the respective va[...] Such mule tracks could be easily made [...] relatively small cost. When that prelim[inary] work is done the production of Mollendo r[ubber] will rapidly increase.

At present the main impediment t[o the] development of the industry is not the diff[iculty] of carrying out the rubber, but of carryi[ng in] the necessary supplies; for it is importa[nt to] remember that the forest region is pract[ically] uninhabited, and the amount of cultivati[on] very small. A tropical forest left to [itself] produces little food for man. At one o[r two] points by the river banks, where gold-washi[ng is] carried on, there are small Indian villa[ges], but the inhabitants are fully occupied, [and] have no time to spare for winning the ru[bber]. Both labour and food have therefore t[o be] imported from the high Bolivian plateau b[y the] same route that the rubber retraces on its [way] to export.

We are thus brought to consider the im[port]ant question of labour. In the departmen[t of] La Paz there are reckoned to be over 300[,000] Indians, most of whom inhabit the high pla[teau] region. These people are agricultural labou[rers] who work, under a kind of manorial sys[tem], for what corresponds to a very low rate of [wages], a starvation wage, in fact. They canno[t be] described as an industrious folk, but [they] are extravagant, and their extravaganc[e in] expenditure on festivals, and especially on fe[stal] raiment of a costly and gorgeous charac[ter], leads them to temporary emigrations f[rom] home, to which they are also frequently dri[ven] by dire necessity. They are wont un[der] such circumstances to pledge their labou[r in] advance, and their extraordinary hon[esty] makes the avoidance of their pledge an ev[ent] of extreme rarity. Employers needing lab[our] secure the services of agents who visit Ind[ian] villages, and either directly or through [the] corregedors or presidents of the villages, en[gage] the required workmen. Payment is gener[ally] made in advance, for the Indian has [to] leave money with his family and to p[ro]vide himself with food for the time of [his] absence in the forest. He transports [his] food either on his own back or on that [of] his donkey, and sometimes he takes his w[ife] and family with him. He contracts either [to] work for so many days or to bring out of [the] forest so many pounds of rubber. The ti[me] spent by him on the journey to and fro is [not] paid for. In the case of a mine or other ent[erprise]

: that has been running for some time, -tain number of Indians become habituated orking for it, but they generally do so only portions of the year, returning at stated vals to their homes for the purpose of uing the cultivation of their lands. All ends upon how the Indians are treated by employers. If they are well treated they return and bring others with them, even out payment in advance, if provisions are lied to them at the place of labour. The em is not a very satisfactory one, and is not ible of indefinite extension, though un-otedly if the forests were worked on a large e, and the Indians were well treated and ctually paid, a change in their habits ht be brought about. It is not, how-, probable that the forest region could be colonised by plateau Indians, the rence of climate and level between the countries being so strongly marked. enever an organised attempt is made to oit the splendid forests on a large scale, ign labour will have to be imported, and it be necessary to seek Chinese coolies in Francisco, or Italians from Buenos Ayres, o fetch Hungarians from Europe. Such nists would live in the forests and would ivate the ground as well as work the rubber s. Their labour would be supplemented by of Indians, but a steadier industry would he result.

he method of extracting rubber is one of simplest crafts in the world, and can be nt by the most ignorant in no time. The cess is as follows:—The workman, starting very early in the morning (for when the is high the trees cease to bleed), carries 1 him a number of little tin cups, called *elas*. Arriving at a tree, he makes one or e small incisions in the bark, and below h attaches one of the tin cups by pressing ito the soft bark. The number of incisions t can be made in a tree at one time is ously stated. A strip of the bark all down tree, one-third of the circumference in th, must be left unbroken, or the tree will liable to bleed to death. The cup, of rse, collects the drops of sap that bleed 1 the wound in the bark above it. Ulti-ely the wound in the bark is covered by a of dry sap, which also is afterwards col-ed. The workman proceeds from tree tree, attaching his cups, till he has ped from seventy-five to one hundred fifty trees in his *estrada*, according to industry and the nature of the ground. After the hour when the sap ceases to run, the man goes round again, carrying a tin vessel with a cover, into which he pours the milk that has run into the *tichelas*. When all the *tichelas* have been emptied, the man returns to his *barraca*. Some collectors tap the trees in the morning and return to collect the milk in the evening, whilst others tap in the evening and collect in the morning. At the *barraca* the collector lights in his hut a fire of palmwood, with which the nut of the Montacu palm is mixed, if it can be obtained. He places a funnel over it to collect the smoke, and then, taking a kind of small wooden paddle (something like a squash racket bat) in his hand, dips the broad end into the milk, which covers it with a thin layer. He now holds the paddle over the fire in the smoke, turning its faces alternately to the heat. The layer of milk is thus rapidly smoked and coagulated into hard cured rubber. The paddle is then dipped into the milk again and the process repeated until a large cake has been formed. When the cake has reached a convenient size it is slit down the sides and stripped from the paddle. The figure-of-8-shaped lumps thus formed are ready for export. They still contain about 7 per cent. of water which gradually dries out in the next few months, and for which allowance must be made in weighing. In the Mapiri district, it is usual to cure the production of each day separately, so that each collector's work can be controlled. Moreover rubber so cured can be easily tested for cleanness and purity. Lower down the Amazon the custom is to smoke one day's rubber on top of the previous day's, making larger *bolachos*, into which dishonest workmen more easily intro-duce stones and other adulterations.

The average amount of rubber which one collector produces on one day is very variously stated. On the Lower Amazon 7 lbs. daily is the figure quoted, on the Upper Amazon 21 lbs. daily. In the Mollendo district the lower of these figures does not appear to be reached under present management. To this cured rubber must be added the scraps and remnants called *sernambi*, which include the cicatraces of the incision of the bark, the cleanings of the *ticheles*, &c. The amount of the *sernambi* is equivalent to about 10 per cent. of the smoked rubber; its price is from 15 to 20 per cent. less than the price of smoked rubber.

The *pica* or rubber-harvest is collected twice a year in the Mollendo forests, from April to July, and from October to March. It appears

that a single tree can only be tapped during three months of one year, and then needs nine months' rest. If thus treated, and if a good broad strip of bark is left untapped from bottom to top, the health of a tree does not seem to be interfered with. For how many years it is possible to go on tapping a single tree we do not yet know. There is a tree in the barraca Cristina, in Señor Violand's San Antonio estate, which was stripped of all the bark on one side, and yet had yielded milk from the remaining bark during six *picas* in six successive years; the tree still retains a thoroughly healthy appearance. It is certain that the life of a tree, though annually tapped, is a long one, and exceeds the fifteen years which are required for the growth of a tree from seed, so that the forest may be perennially tapped, and will give a fairly constant yield when thoroughly opened up and worked. This, however, implies that the trees are carefully handled; the yield of a mishandled tree falls off. The average yearly output of a full-grown tree is variously stated. Some put it as high as 7lbs.; no one puts it at less than 3 lbs. of cured rubber (after 10 per cent. has been deducted for drying).

The cost of production in Bolivian dollars for 100lbs. of Mollendo rubber in the Mapiri forest is as follows:—

	Dols.
Paid to contractor per 100 lbs.	73·00
Loss in weight, 10 per cent.	7·30
Freight from the forest to Sorata town	5·00
Commissions and road tolls	·60
Cost of administration	10·00
Sacking, packing, commission, and freight to Chililaya on Lake Titicaca	2·20
Freight, insurance, and incidental expenses to London	12·00
	110·10

Or reckoning the Bolivian dollar at 18d., the cost of 1 lb. of Mapiri rubber put in London is 19·82d.

From the books of two other forest owners in the same neighbourhood I find a slightly higher cost, 20·16d. per lb. The present price of this rubber in London has now risen, as above stated, to 4s. 1½d. per lb.

Coming now to a consideration of the possible supply of rubber to be drawn from the Mollendo forests, we enter a region of conjecture, for of course the trees have not been counted nor even the number of *estradas*. A part of one estate has been recently proved to contain 6,410 *estradas* (961,500 trees), when, according to the original estimate, the whole estate contained only 500,000 trees. million trees may be taken as the probable limit of the number of trees, they may not improbably turn out to 10,000,000 or even more. Now in the 1897-8 the amount of Mollendo rubber ex[...] was 491,087 lbs., which at 3 lbs. per represents the yield of only 163,695 tree[...] the same number of days' labour at 3 lb man per day. If one Indian is tak[...] working for three weeks, this represent[...] labour of only 7,795 Indians out of a popu[...] of 300,000 in the department of La Paz the lowest reckoning, therefore, the out[...] Mollendo rubber might be increased 3[...] without planting a tree. How is this de[...] ment to be attained?

Without going into financial questions cerned with any possible purchase o[...] estates and concentration of them under [...] management, a few essential features o[...] problem may be pointed out. To begin the first necessity is to make good mule [...] over the high passes that lead from the of Sorata and from the Bolivian plateau t[...] chief eastern valleys and down those valle[...] the forests. These roads would, of cours[...] very useful to the gold miners, coffee plan[...] and others whose work leads them to the [...] ward. They are, therefore, rather work[...] the Government than for the rubber-f[...] proprietors; but the Government is poor cannot afford to make them. If made at in the immediate future, the forest propri[...] must make them. The main roads ha[...] been made, it is necessary to cut forest tr[...] from one *estrada* to another, as only *estradas* easily accessible have yet touched. This implies additional labour, oversight, and intelligent exploration.

At present all the food consumed by rubber collectors has to be carried in to forests from Sorata or the plateau—a g[...] waste of labour. It would be perfectly ea[...] raise any quantity of food in the hot val[...] which are of the richest natural fertility; such cultivation implies preliminary col[...] sation. As already stated it would be im[...] sible to colonise these low, hot valleys Indians from the Tibet-like plateau. Chi[...] coolies are the class most suited for such w[...] They could be obtained very easily from Francisco. A nucleus of such men, who w[...] soon become expert in working the ru[...] forests, would enable the industry of ru[...] collection to be far better organised than i[...] to-day, and opportunities of theft would

uced. Large areas in these valleys which not carry rubber are suitable for coffee ntations, and such plantations as do exist duce the finest coffee of South America, l some of the finest in the world, so that e also important future developments may expected. What is true of coffee is true o of coca, for which a large local market sts among the Indians of Bolivia. Such velopments of the rubber industry imply, merely concentration or co-ordination of oprietorship, but skilled administration and entific experience, which could only come in wake of capital. At present everything is ne experimentally, or by rule of thumb.

The Bolivian Government would certainly our such an enterprise providing that road-king and colonisation were an essential ture of it. With their help the business of ruiting Indian labourers would be greatly ilitated, for the village corregidors have ch influence over the Indians, and can omote or hinder their enlistment or turn m in one direciton or another very much as y please. Under any circumstances, how-r, the future of this region of tropical lleys, descending from the eastern face of snowy Cordillera Real of Bolivia is certain be prosperous, and its development will ract much attention.

DISCUSSION.

The CHAIRMAN said he had always noticed that ening to an interesting paper awakened a desire for ll more information, and there were one or two ints on which he hoped Sir Martin Conway would rther enlighten them. He had told them that the ly chance of developing the rubber industry, which emed to be the most important in the country, was making further means of communication with the rests, and that the first essential was to make mule-ths on the further side of Sorata. He did not ow what the distance was, but hoped they would opened before long; he would, however, ask if the untry could not be opened up better by means of lways? At any rate, judging by the photographs, did not seem as if on this side of Sorata there uld be any insuperable difficulties to overcome, and should like to know if they were insurmountable the other side. Of course it must be anticipated at there would be enough traffic to make such a e pay; but it must be borne in mind that there re possibilities of making narrower and cheaper lways than anything hitherto introduced. He erred to the Lartigue system, of which an example s about to be established between Liverpool and anchester, to run at a speed of 100 miles an hour. He did not suggest that a railway should run at that speed in Bolivia; but the system was not only remarkable for its speed, but for being specially adapted for use over rough ground, there being only one line on which the trucks were hung. It was stated that the wages paid the natives were ridiculously low, but it was proposed to obtain Italians to work there. Was it anticipated that they would do so much better work, that it would make up for the increased wages they would have to receive? It was quite possible that would be so, but it could only be done by introducing improved methods of making rubber from the milk, and possibly of getting the milk from the trees.

The BOLIVIAN MINISTER said he was very glad of the opportunity of expressing his gratification in hearing this interesting paper by his friend Sir Martin Conway. He believed that the great esteem in which he was held was due not only to the great pluck and enterprise he had shown in surmounting immense difficulties and ascending to such enormous heights, but also on account of his keen spirit of observation of the habits and resources of the various countries he visited, and which he had so graphically described. It was his duty to thank him in the name of his countrymen for the manner in which his lectures and papers on Bolivia had contributed to make that part of South America better known, and his description that evening of the resources of the country would no doubt call the attention of scientific people to its importance. He had described very vividly how Bolivia was endowed with some of the most important products, owing in great part to the great variety of its climate and altitude. Still, all these resources remained almost entirely undeveloped, on account of the scanty population scattered over a wide area, and the want of means to build railways and navigate the rivers, so as to place it in more immediate connection with the commerce of the world. The production of rubber was even more important than the figures quoted would indicate. Sir Martin Conway spoke of 1,000,000 lbs. as the export from Mollendo, but that did not include that exported by way of the Madera river, which was so considerable that it brought the total export in 1898 up to 3,100,000 kilos., or in value about £1,100,000. The production of silver was about 10,000,000 ounces, or about £1,000,000 sterling in value, and copper from the district of Corocoro alone, though that was by far the most important, was exported to the value of £200,000. The extraction of tin also had lately become very considerable, amounting to about 6,000 tons, or, at present prices, £600,000. Antimony, bismuth, gold, &c., would come to between £200,000 and £300,000 more, so that the exports of these would alone amount to between three and three and a-half millions, due principally to local effort, for hitherto hardly any foreign capital had been introduced. The institutions of Bolivia were very liberal,

and the mining laws and regulations for the grants of land were well calculated to encourage investment. At the head of the Government was a man whose greatest services to the nation had been as an explorer and pioneer of civilization in the regions which had now been described, and in the basin of the Amazon where there were thousands of square miles yet to be explored.

COLONEL G. E. CHURCH said he was delighted with what Sir Martin Conway had told them of Bolivia. With regard to railways it must be remembered that the country was about twice the size of France, and was perfectly Mediterranean since the war with Chili, which cut of the coast. All the imports had now to go through the Chilian ports, generally through Chilian merchants, who squeezed them all they could. To reach Bolivia by crossing the Andes would be a herculean task, for no locomotive could drag a paying load up over those mountains, consequently all freights were very high, almost prohibitory, and in the case of the smaller lines which ascended the Peruvian mountains you saw mules alongside the track, competing with the railway, and carrying loads of 300 lbs. Sir Martin Conway had dealt mainly with the resources of the country; he had pointed out the gold belt on the eastern slope of the Cordillera Real, and the silver belt on the western slope. He remembered once being on the eastern slope of Illimani, when a gentleman drove up to the house where he was staying and took out of his pocket a nugget of gold, of about $1\frac{1}{2}$ ounces, which he had picked up as he crossed a ford. There was no doubt that every stream that flowed from that slope ran over sands of gold, and that you might wash gold anywhere where there was a little sandbank. But that gold belt did not stop there. On the opposite side there was a ridge, called St. Simon's Ridge, over which in olden times the Portuguese and Spaniards frequently crossed swords on account of its universal wealth. Rich, however, as Bolivia was in minerals, it was nothing to the agricultural resources of the country; once it were furnished with cheap transport. He considered it the finest 400,000 square miles in South America. How much it could produce he should not like to say, but he believed its future lay in its agricultural development. At present, unfortunately, it produced very little. In 1825, the whole revenue was only about £500,000 per annum, and now, after 75 years, it was rather less. The little silver and other minerals she was able to export, barely paid for her imports, and the Government was in a constant state of poverty. He had always maintained that the only real access to the counrry was by the Amazon and Madera. At the falls of San Antonio, however, began a series of falls and rapids covering 270 miles. The river Beni flowed into the Madera at the fifth rapid, and had a fall at its mouth of about 30 feet; then ascending that river for about 400 miles you came to the town of Reyes, the last point of useful navigation. This river flowed through one of the richest districts in the world this was really the great rubber district whicl now being developed, the produce being carri canoe down to the Madera, at great cost and frequent wreckage. The whole valley of the Ma was a plain of about 115,000 square miles, 35,c which were annually flooded, and when the w retired they left a soil as rich as the Nile vall not more so. This was the one spot which, i mind, was suitable for European colonisatio it lay at an average elevation of about 600 The district which the river flooded was swa but this was delightful, and by building a rai round the Falls of Madera, about 2,500 square would be opened up. All the produce of that di would then be accessible, including the coffee-gro belt; and he would go further than Sir Martin way, and affirm that the coffee was superior to Mo and took the first prize at the Paris Exhibition. A to Bolivia from the Argentine Republic was difficult and costly, and to go over the Andes practically impossible. The real route was by Madera.

MR. R. KAYE GRAY confirmed what had l said by the Bolivian Minister and Colonel Chu that the greater part of the rubber from Bo came down the Madera; the quantity which c down *viâ* Mollendo was insignificant. He been to Lake Titicaca, but could not pretend know the district. It was certainly a great ad tage to have railway communicaton as far as the la but as that stood at an elevation of 13,000 f and all produce had to be taken to that height, route did not seem well fitted for commercial p poses. Some years ago he met Mr. Martind who was much interested in trying to develop rubber industry on the eastern slopes of the An and in discussing the matter with him he came the conclusion that the labour question, includ transport, was the chief difficulty. Still, Martindale had been able to do something, the rubber was certainly very good, fetching ab 2d. a pound less than the finest Para, and 3d. than what was known as Bolivian rubber. inferior quality and scraps probably did not pay carriage. Being interested in rubber, and finding very difficult to turn out electric wires and waterpr garments wtth Para rubber at 4s. 5d. lb., he sho rejoice at any development of the production of go rubber.

MR. R. H. BIFFEN asked if Sir Martin Conway co assure him that the rubber trees he had spoken were really the *Siphonia elastica* of the Amaz because from the description given, it hardly seem likely. As known in the Amazon valley, that spec always grew on soil which was flooded part of t year, and when transported to Ceylon, where the situ tion was somewhat similar to that described in Boliv the trees did badly, and the yield fell off very much

ir MARTIN CONWAY, in reply, said he was not a ınical expert, and unfortunately the specimens he ıght home were lost *en route*, so that he could get them identified. This statement was based the report of the British Consul, Mr. St. John, ı visited Bolivia three or four years ago, and he said : he got his information from an expert, but could not ascertain his name, and could not efore affirm positively that the identification was ıplete. But it grew under conditions practically ilar to a swamp, inasmuch as there was rain falling y from a permanent cloud. It was a very unusual ıate, if not quite unique. The amount of Mollendo ber exported was not quite insignificant, for it ounted to over three million pounds; over half a lion came from the small district over which alone had an opportunity of examining, near Sorata. Of rse the great forests in the neighbourhood of the ıi river could produce a vastly greater quantity n the little district he had mentioned, and its full elopment could only result from the opening of the Amazon route. As for railway developnt generally, there was the line from Antofota to the shore of Lake Titicaca, and the whole a alongside it was very rich in minerals. Sicasica, f-way between Uroro and La Paz, was also a rich ıeral district, but it produced practically nothing, lack of means of transport. Even fuel had to be ried up if the mines were to be worked. He did believe there would ever be a trans-Andean ilway. It had, however, only cost a few hundred ınds to make the mule tracks necessary to work little district he had referred to. With regard to our, there were plenty of Indians, but you could get them to stay at work more than three weeks a time, and therefore it was very difficult to ganise the proper cultivation of the rubber industry. could only be done by importing colonists, who uld not only look after the rubber, but cultivate the ound and provide their own food.

The CHAIRMAN then proposed a cordial vote of anks to Sir Martin Conway, which was carried animously, and the meeting adjourned.

Correspondence.

VENTILATION WITHOUT DRAUGHTS.

Your correspondent, Mr. F. C. Nunn, has been od enough to criticise my paper on "Ventilation thout Draughts," and taking his remarks seriatim, would point out that it *was* my intention to show it the vacuum system is responsible for many ıughts; while the plenum system is free from this l; moreover, the term "barbarous" is not the st too strong when applied to the draughty ults of a ventilator in the roof.

I stated a simple fact that under the plenum system, air leaves the room through the same orifices where it enters under the vacuum system; and, if your correspondent will take the trouble to feel under the doorway, inside and outside a closed room with a fire, he will admit that my contention is correct.

We do not all want to live in hospitals; and, although what he describes in connection with the one at Ventnor is interesting enough, yet the warming and ventilating of hospitals formed no part of my paper, and it was impossible to widen its scope in a single evening to include everything that might be said in connection with ventilation. Carbonic acid gas *does* fall, as I say, after it has been dragged up by currents of air, and has cooled down; and this may easily be perceived in churches, and other lofty buildings. The illustration of a smoker looks very like a "misleading theory." Smoke coming out of a burning pipe, and discharged through the nostrils, as through a chimney, cannot fairly be compared with air from the lungs at a much lower temperature. Fresh air coming in compact volumes from open windows, hardly comes under the head of *draughtless* ventilation. If, however, a proper system were carried out, with the ventilation acting automatically, and independently of the windows, the Association for the Prevention of Consumption would doubtless word their Leaflet No. 3 of 1899 somewhat differently.

As the last sentence in Mr. Nunn's letter agrees with what I myself have maintained, I need say no more in defence of modern ideas, against arguments, which, although popular, have already been refuted by General Morin, Lord Kelvin, and other scientific men, in whose company I am very content to be included. ARTHUR RIGG.

PARISH WATER SUPPLY AND SEWERAGE.

Mr. Meade-King has prepared some diagrams in accordance with the suggestion of Sir Alexander Binnie in the discussion on his paper (see *ante*, p. 208). It is unfortunately necessary to postpone the publication of these until next week on account of want of space.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

FEBRUARY 7.—"Housing of the Poor." By EDMUND WILSON.

FEBRUARY 14. — "The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD. SIR WILLIAM DE W. ABNEY, K.C.B., F.R.S., will preside.

FEBRUARY 21. — "Artistic Copyright." By EDWIN BALE. SIR L. ALMA TADEMA, R.A., will preside.

FEB. 28.—"Pneumatic Despatch." By PROFESSOR CHARLES A. CARUS-WILSON, M.A.

*** Prof. Carus-Wilson will read a paper on this subject on this date, in place of one on the "Electrical Induction Motor on Mountain Railways," previously announced, the reading of which is postponed.

MARCH 7.—"Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources." By DR. CARL PETERS.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock :—

FEBRUARY 8.—"New Projects of Railway Communication with India." By JAMES MACKENZIE MACLEAN, M.P. LORD EDMOND FITZMAURICE, M.P., will preside.

[This meeting will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

Tuesday or Thursday afternoons at 4.30 o'clock :—

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

CANTOR LECTURES.

Monday evenings at 8 o'clock :—

BENNETT H. BROUGH, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

LECTURE III.—FEBRUARY 5.

Sources of the world's supply of iron ore—Principal mines now worked—Future resources.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bennett H. Brough, "The Nature and Yield of Metalliferous Deposits." (Lecture III.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Prof. J. Lane Motter, "Meteorology."

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Inaugural Address by the President, Mr. Henry O'Connor.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Dr. W. S. Squire, "Recent Objections urged against the Adoption of the Metric System." 2. Mr. H. R. Le Sueur, "Oil of Carthamus Tinctorius (Safflower Oil)."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. H. F. Eaton, "Victoria and the Federation of Australia."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. President's Address to Students.

Camera Club, Charing-cross-road, W.C., 8¼ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Major-Gen. Sir C. W. Wilson, K.C.M.G., "Moab and Edom."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. F. G. Aflalo, "A Moorish Capital."

TUESDAY, FEB. 6...Royal Institution, Albemarle-street, 3 p.m. Prof. E. Ray Lankester, "The Struc and Classification of Fishes." (Lecture IV.)

Central Chamber of Agriculture (at the Hous THE SOCIETY OF ARTS), 11 a.m.

Civil Engineers, 25, Great George-street, S.W p.m. 1. Mr. W. B. Farr, "Moving Load Railway Underbridges." 2. Mr. C. F. Fin "Note on the Floor System of Girder Bridges

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m.

Biblical Archæology, 37, Great Russell-street, W 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. J. M. Fawcett, "Notes on the Transformatio some South African Lepidoptera." 2. Mr. field Thomas, "Mammals obtained in So Western Arabia by Messrs. Percival and Dobs 3. Mr. L. A. Borradaile, "Collection of Dec Crustaceans from Freshwaters in North Borne

WEDNESDAY, FEB. 7...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. Mr. Edmund Wil "Housing of the Poor."

Geological, Burlington-house, W., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 Mr. J. Castell-Evans, Soil and Local Phy Conditions."

Archæological Association, 32, Sackville-street, 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m. An Meeting.

THURSDAY, FEB. 8...SOCIETY OF ARTS (East Confer Hall, Imperial Institute), 4½ p.m. (Indian Secti Mr. James Mackenzie Maclean, "New Proj of Railway Communication with India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries. Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8 p.m. Prof E. Thorpe, "Victor Meyer Memorial Lecture.

London Institution, Finsbury-circus, E.C., 6 Mr. J. Churton Collins, "Curiosities of Criticis

Society for the Encouragement of Fine Arts Conduit-street, W., 8 p.m. Mr. E. Foley, " Household Gods: their Designs and Designers

Royal Institution, Albemarle-street, W., 3 Prof. H. H. Turner, "Modern Astronon (Lecture I.)

Electrical Engineers, 25, Great George-street, S. 8 p.m. Mr. R. P. Sellon, "The Standardisa of Electrical Engineering Plant."

Mathematical, 22, Albemarle-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8¼ Mr. A. A. Campbell-Swinton, "Steam Turbin

FRIDAY, FEB. 9...Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting. 9 p.m. Dr. J. Reyn Green, "Symbiosis and Symbiotic Fermentatio

Civil Engineers, 25, Great George-street, S.W p.m. (Students' Meeting) Mr. D. E. Ll Davies, "Underground Sources of Water-Supp

Astronomical, Burlington-house, W., 3 p.m. An Meeting.

Sanitary Institute, 74A, Margaret-street, W., 8 Dr. Herbert Menley, "Sanitary Land in United Kingdom."

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlingt house, 5 p.m. Annual General Meeting. Add by the President, Prof. O. J. Lodge.

SATURDAY, FEB. 10..Botanic, Inner Circle, Regent's-p N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. W. L. Courtney, "The Idea of Tragedy in Anc and Modern Drama." (Lecture I.)

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FRIDAY, FEBRUARY 9, 1900.

communications for the Society should be addressed to he Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

n Monday evening, Feb. 5, Mr. Bennett Brough delivered the third lecture of course on "The Nature and Yield of alliferous Deposits," in which he specially lt with the sources of the world's supply of ores.

he lectures will be printed in the *Journal* ing the summer recess.

COVERS FOR JOURNAL.

'or the convenience of Members wishing to d their volumes of the *Journal*, cloth ers will be supplied post free for 1s. 6d. h, on application to the Secretary.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, January 30th, 1900; Sir George rdwood, K.C.I.E., C.S.I., in the chair.

he Chairman, in introducing the reader of the er, said:—Mr. Cyril Davenport has already oured the Society of Arts with his Cantor ures on "Decorative Bookbinding," in January, 8, and with a paper on "The English Regalia," vered before the Applied Art Section of the iety, February 22, 1898, and another on "Vitre- Enamels," delivered before us, February 21, 9. He is the author of a standard work on, entitled, "The English Regalia," and of two ks on bookbinding, namely, "English Royal kbindings" and "English Embroidered Book- lings;" and I read the other day that he is paring a third on "Thomas Berthelet, Royal kbinder to Henry VIII." to be published by Caxton Club of Chicago. He is also in charge of the bookbinding department of the British Museum, and is binding editor of Lady Randolph Churchill's sumptuous quarterly *The Anglo-Saxon Review*, the covers of which are always to be reproductions of selected master-pieces of the greatest bookbinders of Italy, France, Germany, and England. But Mr. Cyril Davenport is not only learned in the history of the industrial arts in which he is most interested as a man of good taste, but is himself practically proficient in some of them. This double qualification of his as an authority on the industrial arts is the explanation of his success as a lecturer on them, and the attention and pleasure with which this Section heard his two previous lectures, illustrated as they were with all the dainty cunning of his own deft hand, will be his best assurance of the grateful and hearty welcome with which we shall receive him here to-night.

The paper read was on—

NIELLO WORK.

By Cyril Davenport.

The study of niello work perforce carries us back to the subject of engraved designs on metals, with which art it is intimately connected. Such designs were at first used as finished ornamentation in themselves, as, for instance, the beautiful Greek engravings on bronze, many of which were found at Corinth, and date as far back as the 5th century, B.C., or possibly earlier; or the Etruscan work of similar character, in mirrors and caskets of a still earlier period.

Subsequent engravings on metal, known specimens dating back to about the first century, A.D., were treated with a further process, the engraved lines being filled up with a black metallic amalgam, now known as "niello," and, finally, some time during the 15th century, the engraved plates began to be used only as originals, for which prints could be produced in quantities. It is interesting to know that prints were actually made for engraved plates intended for niello; indeed, for a long time it was considered that such "proofs" were really the first prints made from such plates. But that belief is now modified. Prints made from "niello" plates are highly valued, and always have words and dates reversed. They can have been of little use, and were probably only made as experiments.

Niello is applied to a metallic surface in a similar manner to that used in the case of vitreous enamel. A design is cut out of the metal plate, and the niello is put into it, or

over it, melted, and the superfluous residuum scraped off. Niello is itself metallic, therefore it is less liable to chip off than vitreous enamel, the expansions and contractions of the metal bed being more nearly in accord with its own movements from the same cause.

The earliest mention of niello work is in a remarkable treatise, written by Eraclius, about the middle of the 10th century. The original of this treatise, "De Artibus Romanorum," is lost, but there is a copy, dating from the 13th century, in the British Museum (Egerton MS., 840 A.).

Eraclius says the niello should be made of "equal parts of quicksilver, copper, and lead, fused together with sulphur; then take atramentum (probably sulphuric acid), tempered with wine, and make what yon wish upon silver with the atramentum, and overlay it with the metal, and a beautiful niello will be made."

The next important mention of niello is in the treatise "De Diversis Artibus," written by the monk Theophilus in the first half of the 11th century. It was translated by Robert Hendrie in 1847. Theophilus quotes from Eraclius, and there are copies of his MS. at Paris, Vienna, and London. His receipt differs a little from that given by Eraclius, and is as follows:—Silver, 1 part; copper, $\frac{1}{3}$ part; and lead, $\frac{1}{6}$ part; all to be fused together with yellow sulphur by melting in a crucible. Cool and powder, and apply to the metal at a low heat with "parahas gum," which Mr. Hendrie thinks is borax.

Theophilus further says you can make a stick of niello and rub it on to an engraved plate made hot. For polishing, he recommends stone powder, mixed with saliva, rubbed on with a piece of lime-tree wood, to be finally finished by rubbing over with "wax from your ear!"

In the "Trattato dell' Oreficeria," of Benvenuto Cellini, published at Florence in 1568, there is mention again of niello. He advises a different proportion of the same ingredients, namely: silver, 1 part; copper, 2 parts; lead, 3 parts; all to be melted together and mixed with powdered sulphur and borax. He also says that the heated plate should be coated with borax, and the niello applied at a low heat. It easily burns. Rub it over with a hot spatula; file off when cold, and burnish while warm; polish with tripoli, charcoal, and a reed.

The mixture I have used successfully, under the advice of Mr. R. E. Atkins, of the Techical Schools of the London County Council, is composed of silver, 1 part; copper, 3 par lead, 6 parts; being the same as that reco mended by Cellini, but with a larger proport of lead and copper. This is fused with s phur, cooled and powdered, and used w sal ammoniac. I succeeded better as to firing with the blow-pipe than I did with furnace.

The word Niello is an Italian form "Nigellum," and the art itself is usu associated only with Italian work of 15th century, but in fact it is of much ear origin.

FIG. 1.—BRONZE STATUETTE OF ROMA EMPEROR.

About the first century. Inlaid with silver and niel Height 22 inches.

There is a considerable amount of small ello work in silver and bronze, dating about e first four centuries of the Christian era, of oman workmanship. Statuettes, fibulæ, and ntres of silver dishes are especially favoured; me of these are heightened in effect by rty gilding.

A complete set of toilet accessories of silver longing to a Roman lady was found near the squiline Gate in 1793. There are several eces of niello work among them, all small, d with accessory gilding. The whole set is ntained in a beautiful repoussé silver casket, d was made about the 4th or 5th century. n inscription on the lid mentions the names the bride and bridegroom, and their portraits e also given in repoussé work. There are so monograms of the names Turcius and ojecta in niello, and slight gilding, on the shes, round and rectangular, which were und in the casket.

About the time of King Alfred in this untry there appear to have been made a umber of gold ornaments with niello. Those have to show you pictures of this evening are old rings, and they are remarkable pieces of wellery. They are heavily made of pure old, deeply engraved, and the depressions

FIG. 2—ANGLO-SAXON GOLD RING WITH NIELLO.

ipposed to have belonged to King Ethelwulf, A.D. 836-857.

led with niello. In all cases the niello has a ueish tinge, and I have not yet been able to ecide whether this colour is apparent or real. think it just possible that the lead which is iven in the receipts for making niello has in ese cases been omitted—we all know what a angerous thing it is to melt lead with gold— d some other metal substituted. Anglo-axon nielli are also found on silver and onze.

Of Celtic workmanship I have only one ecimen to show you; it is, however, a very e one, and associated with inlays of silver. Ireland there are I believe several fine ecimens still preserved, mostly on bronze.

There are instances of niello work to be found on the enamels of the beautiful "Pala d'Oro" at Venice. This is the finest existing specimen of Byzantine church ornamentation and consists of a large number of enamelled plaques representing various scenes from Biblical history, portraits of saints, &c., and the lettering in these enamels are in niello.* They date generally about the 10th century.

In the 13th and 14th centuries most of the specimens of niello work I have been able to find are of French origin; they consist of small silver plaques used as adjuncts to the ornamentation of religious vessels, croziers, reliquaries, &c.; then in the 15th century came the large engraved and nielloed silver plaques used chiefly for decoration of the Pax. In these cases the nielloed plate is the chief feature, and during this period it loses its "accessory" character. The most celebrated engraver that used this process was Tommaso, or 'Maso, Finiguerra, of Florence; he was known by repute to Benvenuto Cellini and highly esteemed by him. The process of niello was also largely used for the decoration of churches in various ways, small altars, sacred cups and vessels, crosses, reliquaries and bookbindings, and at a later date its use was extended gradually to secular objects, and it is found on sword handles, knives, buckles, bracelets, rings, and coffers.

Russia, Siam, Turkey, Burmah, and Italy, have all to some extent kept up the art of niello, but most of the modern work certainly is made in Russia, in the Caucasus. The objects decorated are various—powder flasks, helmets, and all kinds of small objects—but not by any means all religious.

At the time of Finiguerra, or shortly after it, it was not uncommon for the engraver to make a mould of his work in the metal, with fine clay, into this he poured melted sulphur, and inked the resulting cast. The result is a complete replica of the original engraving. These sulphur casts are now highly valued; in many instances the original plates, from which they are made, are lost.

The celebrated Pax of nielloed silver representing "The Coronation of the Virgin," engraved by 'Maso Finiguerra, was reproduced in sulphur before the niello was put on. Two of these sulphur casts are now known, but a still rarer impression from the same plate is preserved at Paris; it is on paper, and for a long time was considered to be the first print taken from a metal plate.

* "Encyclopædia Britannica."

The question of the origin of the process of making prints on paper from an inlaid metal plate has been the subject of much learned discussion. It will be found debated from all points of view, in the writings of Bartsch,* Vasari,† Dutuit,‡ Duchesne,§ and several others, the net result being that as far as is now known, the idea was first carried out about the middle of the 15th century. I hardly think myself that it arose because of niello work, for this reason. An impression on paper from the inked plate is reversed, and to correct a plate what is called a *contre-epreuve* is required. From this point of view the casts in sulphur would have been of real use, whereas the paper impression would be valueless. The discovery, indeed, may have been accidental, as Vasari considers it was. It is, at all events, safe to say that a print was made from Finiguerra's plate, about 1450, before it was nielloed, and also that, for the purpose of correcting the plate, this print was of little or no use.

Except the Italian artist-goldsmiths of the 15th century, and the Anglo-Saxon "Edward," who made a gold ring for "Ethred," the names of niello workers are not much known. But during the 15th century there are plenty of well-known names. The niello workers of Florence, besides Finiguerra, include Antonio Pollajuolo, Amerighi, Bandinelli, and Brunelleschi; at Bologna worked Francesco Francia; at Milan, Ambroglio Foppa and Daniel Arcioni; at Geneva, Tagliacarne; at Cremona, Tomaso Fodri; at Modena, Giacomo Porta; and, besides these, there are a host of less celebrated artists.

After this the aim of niello work has been on a lower level. Small ornamental work has been done, and still is in Russia, France, Italy, Siam, and other places. The art is a beautiful one, and might well be used in silver jewellery here.

To illustrate these remarks, I have a series of slides to show you, which I have divided into three divisions. Speaking generally—

The first shows the early work, dating from the 1st century to the 14th, consisting chiefly of Roman, Anglo-Saxon, and Celtic specimens, with one or two pieces of French and Italian 13th and 14th century work. All small, and generally secular.

* Bartsch. "Essai sur l'histoire de la découverte de l'impression des Estampes." Paris, 1811.

† Vasari. "Vite dei Pittori e Scultori."

‡ Dutuit. "Manuel de l'amateur des Estampes." Paris, 1884.

§ Duchesne. "Essai sur les nielles." Paris, 1826.

The second division is that of the Italia work of the 15th century, where the niello is th main decorative point, the engraving mo delicate and refined, and the subjects almo always religious in character.

The third division will show the modern ou come of the two foregoing periods, and giv you some slight notion of the work done fro the 16th to the 19th century, chiefly in Russi Italy, and Siam.

I have taken my specimens chiefly from or or other of our great museums in London, th British Museum, or the South Kensington, t the officials of both of which offices, my thank are due for the facilities they have always give me. I prefer, if possible, to take my example from our own collections, because I feel that makes it easier for any of my audience tha may wish to follow the subject up, to examin the originals for themselves.

The first of the slides I have here this even ing will show a silver plaque in the variou stages of niello working. It is in the Sout Kensington Museum, and was made for thi purpose by Consoli Alfio. Then come th early examples, dating from the 1st to the 14t century.

1. A beautiful bronze statuette of a Roman Imperi personage of the 1st century, inlaid with silv and niello, found near Barking-hall in Suffol —See Fig. 1, p. 246.
2. One of the dishes found in a silver casket ne Rome in 1793. The casket contained toil accessories for a Roman lady, and there niello work and the monograms "Project Turcius" found in the centres of the dishe They are of about the 3rd to the 5th centur A.D.
3. An Anglo-Saxon silver-gilt brooch, with fl garnets and small niello work. About the 8t or 9th century.
4. The Anglo-Saxon gold and niello ring, marke Ethelwulf, found near Salisbury. Of abou the 9th century.—See Fig. 2, p. 247.
5. The Anglo-Saxon gold and niello ring of Ethel with, Queen of Mercia. Found in Yorkshir Of about the 9th century.
6. The Anglo-Saxon gold and niello ring of Alhsta Found in Carnarvonshire. Of about the 9t century.

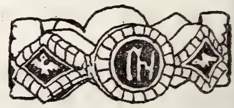

FIG. 3.

7. The Anglo-Saxon gold and niello ring of Ethre made by Eanred. Found in Lancashire, an made about the 9th century.—Fig. 3.

An Anglo-Saxon knife, inlaid with silver and brass, lettered in niello, and made by Biorhtelen. Of about the 9th century.

A Merovingian brooch of silver, party gilt, with small niello patterns. Of about the 9th or 10th centuries.

FIG. 4.

A Byzantine silver dish, with repoussé head in the centre, and richly designed niello borders. Of about the 10th century. Found in Cyprus.

Another Byzantine dish, of the same origin as the last, with a niello cross in the centre.

A gold enamelled Byzantine plaque with head of Christ, the lettering in niello. Of about the 10th century.

14. Two gold enamelled panels from the Pala d'Oro at Venice, with letterings in niello. Of about the 10th century.

The bronze top of the Irish capped Bell of St. Culan, the "Barnan Coulawn," with designs inlaid with silver and niello. Of the 10th century.

Crozier head made by Frere Hugo, the monk, of Oignies, near Namur, with small niello plaques. Early 13th century.

Italian ciborium of gilt copper, with niello plaques; 13th century work.

French reliquary of gilt copper, with small niello plaques, and one large plate with niello; of the 14th century.

A gilt and enamelled binding, with small niello work among the enamel. Probably 14th century.

The next division is all 15th century work, first slide showing the most celebrated ce of niello work known—that to which the covery of printing a paper for an engraved nt is commonly considered due.

Italian Pax of silver, engraved and nielloed by 'Maso Finiguerra, of Florence, and now in the Bargello at Florence. Probably made about 1452. There is a paper print from it at Paris, and a sulphur cast at the British Museum.

An extra slide, showing a print, dated 1446, which, if genuine, negatives the attribution of the earliest prints to Finiguerra.

Italian silver medallion, with niello.

Italian badge in mother-of-pearl, with silver-gilt border having nielli upon it.

5. Italian silver plaque, with nielli,
6. Italian reliquary of silver, with niello of the Virgin and Child.
7. Italian reliquary of gilt copper, with silver panels nielloed, having designs upon them taken from the life of St. Catherine.
8. Italian niello plaque, attributed to Peregrini.
9. Upper part of one side of a silver nielloed binding now at Vienna. It bears the arms of Cardinal Balue, and was given to Pope Paul II. by him
10. Italian Pax of silver in enamelled frame. The Virgin surrounded by Angels and Saints.
11. Italian Pax of silver nielloed with design of the Man of Sorrows.
12. Italian Pax of gilt metal with small niello plaques on the plinth.
13. Flemish cup of silver with niello, mounted in silver gilt. Formerly in possession of the family of Van Bekerhout.

The third division will show you something of the work that has been done in niello since the 15th century.

1. Arabian helmet plate of steel, with name of Arslan Beg in niello. Probably 16th cenrury work.
2. Russian Tcharka with gilding and niello on silver 16th century.
3. Russian cup, with jewelled mounts. Silver, gilt and nielloed. 17th century.
4. Dagger handle of silver gilt, chased and nielloed. 17th century.
5. Siamese Kathôn of silver, parcel-gilt with niello. 18th century.
6. Russian priming horn, silver, gilt and niello. 18th century.
7. One of a pair of pistols from the Caucasus, mounted in silver, with niello. 18th century.
8. Russia cup, silver gilt, with niello. This modern Russian work is generally known as "Tula."
9. Wine flagon from the Caucasus, mounted in nielloed silver and party-gilt. 18th century.
10. Priming horn from the Caucasus, mounted in silver, party-gilt, with niello. 18th centuiy.
11. Military badge from the Caucasus, of silver with niello inscription.
12. Siamese silver-gilt bowl, with designs on a niello background. 19th century.
13. Turkish Yataghan, the silver handle with niello and party-gilding. 19th century.
14. Italian Pax of silver, with nielli. 19th century.

With regard to these slides I must say that there has been considerable difficulty in producing them. This is due to the curious fact that an apparently dark piece of niello, when photographed, shows much lighter than would be expected. I suppose this has something to do with the silver in it, as I have often noticed that tarnished silver shows much whitened in a photograph. Again, silver in the near neigh-

bourhood of niello is often stained a yellowish tinge, owing I suppose to the sulphur, and this photographs darker than would be expected. So between the lightening of the niello and the darkening of the silver, in many instances the design, easily seen by the eye, in the photograph is almost invisible. I have in one or two instances had to bring in the aid of art, but I must ask you to imagine the designs in niello to be actually much darker than they appear in most of the slides.

DISCUSSION.

The CHAIRMAN said:—Mr. Cyril Davenport has reviewed the history of niello so accurately and clearly, as well as concisely, and has illustrated it so copiously and effectively with his magical lantern slides, that in opening this discussion, which can only be a continuous panegyric on all he has said to us, and shown us, I propose to confine myself to the definition and the etymology of the term "niello." Niello is the process and the result of annealing (literally "blackening," *i.e.*, nielloing), or (as I here use the word in its first applied sense) fixing by fusion, on a decoratively incised polished metal (usually silver, but occasionally gold) surface, an opaque, black (non-mercurial) amalgam (sometimes somewhat tautologically called "black enamel" and "enamel de niellure), of silver, copper, and lead. This definition strictly, and I hope correctly, differentiates nielloing, on the one hand, from enamelling proper, or the decorative "painting," or "encrusting" (embedding) of a metallic (gold, silver, copper, &c.) surface (plain relieved, cloisonné, champlevé, &c.), with variously coloured, fused, transparent or opaque, vitreous compositions ("pastes"); and, on the other hand, from damascening proper, or the decorative inlaying or overlaying, by filing, or wedging, and hammering, and polishing a metallic surface (usually steel), with gold or silver wire or figured plates ("crustæ"); a sumptuary variety of the art of inlaying metal with metal (as brass with copper, and copper with silver*, in Southern India), for which Damascus† (literally "The Place of Industry," the "Polytechnical City") ear[ly] became famous; and in which the Saracens, [o]r Hellenized Arabs, everywhere excelled. This d[e]finition of niello also excludes the *bidri* work of Indi[a] so-called from Beder in "the Nizam's Dominions," where it would appear to have been first practised, or, [at] least, to have first become a notable art in Indi[a] although it is also practised at Lucknow, Purneah, a[nd] elsewhere in northern India. In this *bidri* ware silv[er] is decoratively inlaid, by filing, wedging, hammerin[g] and polishing, on a pewetry amalgam of tin, lead, a[nd] copper, blackened on the surface by being treat[ed] with sal ammoniac, saltpetre, common salt, and bl[ue] vitrol: and it may be here mentioned that the "at[ramentum" of "Theophilus the Monk" (iii., 4 "De Colorando Auro") is not sulphuric acid b[ut] either green vitrol, the "atramentum tectorium" [of] the Romans, or blue vitrol, their "atramentu[m] sutorium" [see Sir George Birdwood on "Ancie[nt] and Modern Inks," in the Society's *Journal* f[or] May 6th, 1898]. *Bidri* is not even a reversed niel[lo] as I have seen it defined. It is rather a variety [of] damascene. My definition of niello also exclud[es] Moradabad work, in which the pattern engraved [on] yellow, or on white, metal, is brought out wi[th] apparently some strongly resinated paint colour[s] black, and red, and green, resembling our "Aspir[al] enamels*." A classical example of this Moradab[ad] work is given in my *Industrial Arts of India*, pla[te] 13. In Cashmere also copper is "Kalied," washed over with tin, and then engraven over with diffused floral design, the sunken ground of which [is] blackened either with a lacquer, or by corroding t[he] exposed copper with sal ammoniac, blue vitrol, &[c.] This dainty work is very rare in England, but Lo[rd] Northbrook exhibited three dishes of it at the Pa[ris] Exhibition of 1878. They are blossomed all ov[er] with little raised flowers which shine like frosted silv[er] out of a groundwork of blackened foliated scrolls, traced so delicately as to look like the finest Chanti[lly] lace. A severer variety of this work, obviou[sly] derived from Persian originals, is found at Perhaw[ur]

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* The definition of damascening in my *Industrial Arts of India*, p. 163, which has been adopted by Dr. Murray in his *English Dictionary*, is:—"The art of encrusting one metal on another, not *in crustæ* . . . . but in the form of wire." But, on reconsideration of this definition, I found it too narrow, for it excludes not only the encrusting of brass with copper, and of copper with silver, as is done so superbly at Tanjore [see plates 15, 16, 17, and 19 of my said book], but all the *huft* work of Cashmere and the Panjab, such as the gun-barrel, figured in plate 40 of the *Industrial Arts of India*, save that wrought with gold wire only [plates 36, 31], and all the *bidri* of the Nizam's Dominions, Lucknow, Purneah, &c., [see plates 32, 33, and 35], save that wrought in silver wire only [plate 34].

† One of the wanton irreverences of the so-called "Revisers" of the English "Authorised Version" of "The Holy Bible" is the changing of the reading in Amos iii., 12, from "in Damascus in a couch," to "on the silken cushions of a bed." Because *damasko* is the Arabic for *raw-si[lk]* they thought the Hebrew word *demeshek*, used in Amos i[ii.,] 12, must needs refer, not to the city of Damascus, but "silken cushions." The Hebrew word translated in the A[.V.] by "silk" in Ezekiel xvi., 10, is *meshi*; but the only [un]doubted mention of silk in the Holy Bible is in Revelat[ion] xviii., 12, under the Greek name of *sêrikos*. Damask, as [a] denomination of a silk-stuff, has a double etymology in [the] Arabic *damasko*, "raw-silk," and Damascus, which [be]came celebrated during the Middle Ages for its splen[did] patterned silks.

* The "Aspinal Enamels" were, a few years ago, larg[ely] used in the Madras School of Art for spurious enamelling [on] yellow and white metal, and as the ware was marvellou[sly] cheap and effective, one would not have objected to it [but] for the debased designs with which it was ornamented. [Of] course, the word "enamel" is used for such paints, and the hard varnishes ["Japans," lacquers, &c.] applied [to] metal, wood, leather, and paper, metonymically, or me[ta]phorically only, as when we speak of the "enamel" of [the] teeth, "the enameled skin" of a snake, and "ename[lled] stones," "With Goddes owene fynger wrought."

the Panjab. But, so far as I have been able to ıke out, neither the examples of it from Cashmere, Perhawur, nor the Persian originals of the latter : true nielli; that is, the design on them is not ıckened in with a fused metallic compound, or non-ːrcurial magma or amalgam. The word "niello," the plural nielli, is the Italian form of the Latin ;ellum, a diminutive of niger, "black." We find s diminutive as an adjective in the well-known otation, very pertinent to the subject of Mr. Cyril ıvenport's paper, from Ausonius *Epistola*, iv. -6, (also vii. 48-55) :—

"quum tibi
Cadmi nigellas filias,
Melonis albam paginam,
Notasque furvæ Sepiæ
Cnidiosque nodos prodidit,
Nunc adsit."

·re the context of the "Cnidian reed"-pen *alam* of India), the Sepia ink, and the sheet of pyrus, shows that the "little black daughters of dmus (Cadmi nigellæ filiæ) refer to "the [in-ibed] letters [of the alphabet] Cadmus taught," possibly, to written words. We also find : word as a substantive in such Roman names Nigellus, Nigellio, and Nigella; and in Low tin in the name of the "Fennel Flower," *gella sativa*, the *melánthion* of Hippocrates d Dioscorides, and the "githex" of Pliny; and led the "little-black"-one in Sanskrit, Tamil, legu, Cyngalese, and Persian, as well as in Low tin, from its minute angular black seeds, closely embling the honest gunpowder of our youth. In ·w Latin we also find niello work alluded to, or erred to, or actually described, under the terms of iigellum" and "niellum"—with *melanón* as the eek equivalent; and the forms "nigellatus" and iiellatus" for nielloed. Now niger is hypotheti-ly nec(—er), or nex(—er), and the same word as the tin *nox*, the Greek *núx*, the Sanskrit *nak-ta*, and : English night. *Nak-ta* is from the Sanskrit *nak*, o disappear," "to perish," and cognate with the eek *nekrós*, "dead," *nekús*, "a corpse," and the ıtin nec-are, "to kill, and no-cere, to hurt; and this ɔt reappears, not only in such Anglicised words necromancy, necropolis, and nocturnal, but in such noxious, pernicious, internecine, nuisance, &c Night," therefore, means the dead day, the sky out which the sun has departed, perished, died; and ;er, "black," is therefore, primitively, the colour of ht. Similarly cæruleus, *i.e.*, cæluleus, "blue," ·s back to cœlus and cœlum—or cæelus and cælum 'the sky," "the heavens," and means simply sky-e, the colour, that is, of the heavens lighted up by sun. And does not this derivation of the Latin nes of the colours we call black and blue [note t both these English words are but variants of the rd blow,—and refer to the colouring of a fresh ise—from a blow—of the skin, as in the phrase eaten black and blue"] afford some clue to the con-on, not only among the Romans and the Greeks, also among the Hindus, of the colour blue with black. Many quotations might be given, did time and space permit, in illustration of this confusion from Latin writers. To-night I must content myself with two; the first from Ovid, Fasti iv., 446:—"equi cæruli [Platonis]," "the black horses of Hades"; and the second from Statius, Sylvæ I. vi., 85:—"Nox cærulea", "black night." The most striking instance of the confusion in India is the fact that the darling god of the Hindus, Krishna, *i.e.*, emphatically "the Blackamoor", is usually painted blue, and very seldom black, and more frequently green than black. The confusion of green with blue is to be noticed also among the Romans, Propertius IV., iii., 43, describing the dark green cucumber as "cæruleus cucumis," and Pliny, xxii., 10 (14), the clear blue sky as "viride cœlum." Both the Latin "viridis" and the English "green" refer to the colour of growing, that is virescent vegetation; and again the Latin "gilvus" and "heluus" (= flavus, luteus, &c.), and the English "yellow," all three words being cognate with the Greek *chlóe*, and the Sanskrit Gauri, the "yellow"-haired wife of Siva, from a hypothetical Aryan root *ghal* "to be green," "to be yellow," and also "to be golden," primitively refer to the "greenery-yellery" verdure of the woods and meads in the Springtide of the circling year. Purple goes back to the dark blue colour of lowering clouds reflected from a raging sea. All these are poetical etymologies, always to be kept in memory by the art worker. The word "red" in all its variants, Greek, Latin, English, &c. (*eruthros*, rubus, ruddy, &c.), has also been supposed to be cognate with Aurora (*c.f.*, Rhodopis, Rhodoıa Rhodos; *Rhodanim*, incorrectly "Dodanim" of Genesis x., 4; and Rhode Island, *i.e.*, *Roodt Eylandt*, also Rohita, in Hindu mythology, the red horse of the Sun), as expressive of the colour of the dawning day; but unhappily the hypothetical ultimate root of nearly all the Aryan words (including Aurora, &c.) meaning red is *rudh*, found in the Sanskrit *rudhira* "gore"—shed in the slaughter of man by man. With regard to the failure of the black lines in niello to show up on the lantern slides, it proves that there must be some blue ray from the black lines, if due only to crossed reflections from the silver surface of the object photographed; and it is another illustration of the confusion between black and blue. We know that morally,

"Black's not so black, nor white so very white,"

And it is the same physically, so that we are often able to trace either a glowing, or a chilling shade of blue in both artificial and natural blacks. There are also hues of blue or green which, in the graduated tints and shades of their tones, are scarcely to be differentiated from one another. There is, thus far, a natural explanation of any confusion between black and blue and green, although one fails to understand the extreme examples of it to be found among the Greeks and Romans and the Hindus. In my above given definition of niello, the word "annealed" is said to be synonymous with "nielloed." "Anneal"

is a modification of the Middle English *anelen* "to heat," "inflame," "melt," "temper," *i.e.*, soften by heat, and "to enamel;" and the word seems to have ultimately sprung from the same root as the Old French *neeler* and *nieller* "to enamel," and the Low Latin nigellare "to blacken," *i.e.*, to paint (by fusion) in black upon silver and gold. Mr. Henry Hardinge Cunynghame, in his Cantor lecture on "Enamelling upon Metals," reported in our *Journal* on the 29th ult., quite correctly derives the word enamel from the German *smelzen*, from which our words "smalt," "smelt," and "melt," are directly formed; and then, through the Old French *esmail*, and the later French *ammel* and *email* we are a supposed to have formed the English variant enamel. But it is constantly found that words of long and wide usage, and especially industrial terms, are of complex etymology; and it is strongly to be suspected, particularly considering the overlapping of enamelling, nielloing, and damascening, in the actual practice of these arts, with one another, that both the Old English *anelen* "to anneal,"* and "to enamel" and the Old French *neele* and *nieller*, "to blacken" by firing, "to enamel," have influenced the ultimate form of the English word enamel, or surely otherwise the word would have remained fixed in its Anglo-French form, "ammell," or "amel," as in the lines:—

"Garden of delight. Whose ammell beds perfume the skie."

and again:—

"The Lillies' snowe, And Pansey's various ammell."

Mr. H. LONGDEN said he could not speak as a practical worker in this art, but only as a student of it and of enamelling, in which he had tried certain things, whereas in niello he had not. The extremely interesting and beautiful slides which had been exhibited showed how widely niello might be applied, and it was curious to find it ranging over such an immense length of time. What struck him in the Anglo-Saxon work was that there was in it a boldness of design and fineness of colour, which were very remarkable. He was inclined to think that in this island we had a gift of colour which was shown very early, and had continued with us to the present time. Mr. Davenport had mentioned the "Pala d'Oro" of Venice, and the inscriptions on the plates, of which he had shown two pictures. He did not know whether he had examined the Paliotto in Sant Ambrogio at Milan, which was to his mind an even finer piece of work because it was much less tampered with and modernised. In the "Pala d'Oro" the enamel had been nearly all redone, but in the Paliotto much more of it appeared to be original and almost untouched. As regarded the recent examples, he was much interested to see them, especially the raised work with niello under it, where the grou was cut away and gilded. He remembered t when he was a boy, an uncle of his, a Russ merchant, had a snuff-box which was made in t way; he used to wonder how it was done, a his uncle could not tell him. He remembe that on one side there was a view of the Win Palace at St. Petersburg, and on the other s of the Kremlin. The ground was cut away, a the picture was left on the original surface w niello drawing in black. He had heard the pa with the greatest pleasure and instruction, and t must all be obliged to the author for the care a pains he had taken.

Mr. MATTHEW WEBB said it occurred to h that engraving once on silver, he had unwittin begun what might have developed into niello; a that in years gone by he had had under his ha in the British Museum, for a study and reproduct in drawing, some of the Etruscan work spoken by Mr. Davenport; but niello work truly he kn only as a general student, and from the outside, a indeed, had nothing to say beyond expression of great delight afforded him by the exceedingly bea ful slides exhibited.

Mr. LEWIS DAY proposed a vote of thanks Mr. Davenport for his interesting paper, and showing such an array of slides which were, to certain extent, a revelation. Not the least teresting thing about the paper was that it elicited such a learned disquisition from the chairm which they would all appreciate better when they s it in print. He should like to know if he had corre understood him to say that niello should be defi as the inlaying of a metal amalgam into ot metal, fixed by heat. He did not quite underst why Mr. Davenport should confine the term nie as he understood him to do, to a black patt on bright metal. He did not see why it mi not just as well be a metal pattern on black. Whether you put in the pattern or put in ground seemed to him a question of design, not essential to the process. Mr. Davenp spoke about the impressions on paper from the e engraved metal, before the niello was put in, said they were of no use; but he thought pr ably those impressions were simply taken to kept for reference, or as patterns. With reg to the blue effect of niello upon gold, he thou silver would have a tendency to go blue. It interesting to see the slides arranged as they w into three sets. He liked the first set and the l but considered the second a falling away into pict Mr. Davenport seemed rather to think the ornamen work as a come down, but it appeared to him t when the niellists got to ornamental work they re found out what the art could do, and that s things were more satisfactory than the pictures niello. In French books on art you saw the w

* Unaneled, as in the quotation from "Hamlet," I., 5:—

"Unhousled, disappointed, unaneled,"

is quite another word, meaning "unoiled," that is to die without receiving the last sacraments of the Eucharist, (*i.e.*, Housel—"Hostis") and Extreme Unction.

iello" used to describe those somewhat Arabic tterns you found so frequently in niello work. It oked as if the French writers understood niello to that particular kind of ornamental work to which, his opinion, it seemed best suited.

The vote of thanks having been carried unimously,

Mr. DAVENPORT, in reply, thanked the Chairman the very kind remarks he had made. With regard the enamels in San Ambrogio in Milan, though he d seen them he was sorry to say he did not examine em carefully, but he was careful to show one of enamels in the "Pala d' Oro," which contained portrait of the Empress Irene, supposed to be the st altered of any of the enamels. The second, a rtrait of the Doge Ordelafo Faliero, was conerably altered. Mr. Day seemed puzzled how to tinguish niello and enamel. The process of niello s very similar to enamel, but he thought the best y of distinguishing it was to say that ordinary oured enamel was vitreous, while niello was tallic, and always black, or very nearly so. other distinction perhaps not quite so great, was it vitreous enamel required considerable heat to lt it, but a piece of niello required only a modee heat. It could easily be done with a blowe. He had shown specimens in which the backound was nielloed; it was unimportant whether design or the back-ground was nielloed. As to ich of the three sets of designs was most pleas-, is a matter of individual taste; he should fer the first. At the same time, as a general e, he thought that most people would prefer the lian work. He found it very interesting to study se processes, which went back much further than s generally supposed, and especially he thought t the old work was very frequently extremely fine. e of the first slides, showing the bronze statuette, s a beautiful specimen of art, and the gold Anglo-xon rings were also very charming. The brooches l other articles of jewellery, made by the Anglo-xons about the 9th century, were also very beautiful ngs, and were not sufficiently appreciated. He ped some day he might have an opportunity of ling with this important branch of decorative work a subject by itself.

TENTH ORDINARY MEETING.

Wednesday, February 7, 1900; Sir STEUART LVIN BAYLEY, K.C.S.I., C.I.E., Vice-esident of the Society in the chair.

The following candidates were proposed for ction as members of the Society:—

lshah, K. J., B.A., 1, Wood-street, Calcutta.
rker, F. W., 59, Chancery-lane, W.C.
nderson, John M., jun., King-street Engineering Vorks, Aberdeen.
Walker, Lieut.-Col. R. S. Frowd, C.M.G., Perak *viâ* Penang, Straits Settlements.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, Archibald, 30, Oxford-square, W.
Driver, Prof. Frederick William, M.A., 62, Lancaster-road, Notting-hill, W.
Hancock, Fred, Campbell-place Works, and Lower Wolfe-street Pottery, Stoke-on-Trent.
Jones, John Arthur, Gijon, Asturias, Spain.
Lawrence, Mervyn, 1, St. Leonard's-studios, St. Leonard's-terrace, Chelsea, S.W.
Mullins, Lieut.-General John, Heatherwood, Midhurst.
Penny, Arthur Paul, Primrose Club, Park-place, St. James's, S.W.
Samuelson, Godfrey Blundell, 7, Cadogan-gardens, S.W.
Trapnell, Alfred, 15, Upper Belgrave-road, Clifton, Bristol.

The paper read was—

THE HOUSING OF THE WORKING CLASSES.

By EDMUND WILSON.

I have adopted the above title deliberately; and for two main reasons, first because it is important to label a paper of this kind with a name which conveys some meaning—even if a vague one—to the general reader; and secondly, because the expression has received the approval of Parliament. The "Housing of the Working Classes Act, 1890," is the short title of the first Act of Parliament, dealing rationally with this great though simple problem. I must not, however, omit to point out that the title which I have thus deliberately adopted is too vague, and capable of being misunderstood. Who are the "Working Classes?" the captious critic will ask. The expression really includes many who ride in carriages.

To define the working classes as those who work for weekly wages is good, but insufficient; I would rather say that, for the purpose of the present paper, I mean earners of weekly wages who are unable to provide their own homes. The skilled artisan, earning from £2 to £3 a week, with—it may be—two or three children who are also wage-earners, is in a position to command the house that he requires; he may build it himself, through the aid of a building society (a plan, however, which has its disadvantages, which I will explain by-and-bye); and if he does not adopt this plan, he can

afford to pay a rent which will enable him to secure a suitable dwelling. He belongs, indeed, to the working classes; but how different is his case from that of the unskilled labourer. In every town in England there are men who can earn no more than from 18s. to 21s. a week. In our large towns they are numbered by thousands; the services they can render are not worth more in the market than the sums I have named; and out of that wage they cannot afford to pay more than 2s., or at most 3s. a week for rent; and workers out of doors, such as bricklayers and their labourers and quarrymen have much broken time, especially in winter. When we take into account the price of land in large towns—the cost of building and the requirements of the "Public Health Act"—we find that a cottage house cannot now be built to let for less than 4s. a week. I might even say 4s. 6d. or 5s. I am speaking now of provincial towns—in London rents are much higher. What then is to be done? you will say. That is precisely the question with which I propose to deal in this paper. I am well aware that I am addressing a London audience, and I am confident that what I have to say will be of interest to those who know the metropolis, where the housing problem is most difficult; but in a case of this importance I hold it to be my first duty to give you facts and not theories. I want to tell you what I know *is*, and not what I think might or ought to be. So I will ask you to take a 200 mile journey with me to-night to Leeds—a city having 400,000 inhabitants largely engaged in manufactures of various kinds. During a residence there of more than half a century I have had special opportunities for qualifying myself to speak on this subject, in its bearing on the population of a large and growing provincial town. Leeds is an old town. At the time of the Domesday Survey, at the end of the 11th century, it was of sufficient importance to have "A priest and a mill of 4s.," and though the population is now rapidly approaching 500,000 there were but 33,162 people living within its large area a century ago.

I ought now to explain how I became acquainted with the subject about which I am speaking to you to-night.

In learning and practising the profession of a solicitor, I became acquainted with property of various kinds, and the mode of dealing with it, and I very soon realised the advantage that Leeds possesses in having no building leases. A service of nine years in the Town Council, afterwards familiarised me with local government, but in 1866, I knew nothing of the subject beyond the fact that there were slums in all towns, and that they were generally considered a necessary evil.

It was on the 22nd February, 1866, that a few gentlemen met in my office, for the purpose of improving the dwellings of the working classes. They were all possessed of good intentions, and one of them had, in addition, a competent knowledge of medicine. My business was only to direct their operations from a legal point of view. Dwellings in flats were then being erected in the metropolis, and my friends thought that if they could erect flats in Leeds all would be well. Here we have fallacy No. 1. It is not true that because a certain plan produces good results in London it will be equally successful in a provincial town. I advised my friends to build an experimental block, and to form a limited company, with sufficient capital to provide for development if the experiment should prove successful. The result was the incorporation of the "Leeds Industrial Dwellings Company, Limited," with a nominal capital of £50,000. The history of this company is the foundation of my paper to-night, and I do not hesitate to say that its first operations resulted in absolute failure. An architect was consulted, plans were prepared, and estimates obtained; a piece of freehold land was purchased, and a building four storeys high was erected containing 23 dwellings and a common stair. Then came the need of management. None of the promoters were willing or indeed able to undertake this work, so the building was handed over to a rent collector, who soon found that the people did not like flats, they had not been accustomed to them—they resembled a barrack or workhouse; the idea of patronage and charity was suggested, and there were many practical objections besides; there was a common washhouse on each floor, as to the use of which the women promptly quarrelled; and while in an ordinary cottage house the tenant has his own bedroom above his living-room in a flat it is otherwise—and an ordinary wooden floor separated each man's tenement from that of a neighbour, with whom he was not, perhaps, on visiting terms. Was it reasonable to suppose that he could sleep peacefully in his bed, whilst his neighbour was knocking his wife about in the room overhead? The result was as might be expected, the rents received were insufficient to do more than pay

necessary outgoings. There were no meet-s and no dividends; the co-operators were heartened, the result was a complete fail-, and the moral is: If you do not know how do a thing of this kind successfully, leave it ne! I acted as hon. solicitor in the for-tion of the company, but I knew nothing of management—if I may use the expression of its affairs.

After a lapse of about 10 years, other gentle-n associated themselves together, for the pose of doing that which the original moters had contemplated. They were full good intentions and enthusiasm, and in-med me that they had purchased the block dwellings at a great reduction from its ginal cost. I advised them not to buy the lding, which would have led to the winding of the original company, but to buy the ires, and so keep the company in existence their own benefit. This plan was adopted, shares being purchased for little more than third of their original value! The idea the new operators was the same as it of the original promoters. I had no rt in their deliberations, and I learned it they had obtained plans and estimates the erection of flats, but could not isfy themselves that these plans could be ccessfully carried out. These two suc-ssive failures caused me to think, and to irch for the reasons of a second failure, and idopted the only safe plan in my investiga-ns. I approached the subject with an open nd, being determined to ascertain the facts the first instance, and then to form con-isions from those facts. I have no sympathy th those well-meaning persons who first form eir conclusions and then search for facts on iich those conclusions may be based. I had st to satisfy myself that there were evils eding a remedy; this did not take me long. walk of half an hour's duration in the old rts of Leeds removed any uncertainty that ere might have been on this head. My next int was to find the causes. After careful estigation I established the following facts:

First, prior to 1842 there was no public itrol over the erection of buildings; cottage ises were erected and altered at the will of owner.

Secondly, the original landowner in most ses laid out his land for building purposes l sold it off in small plots; the existence of se small estates is a serious evil, the owner two or three cottages cannot afford to pull down in order to make the rest of his property decent, especially if to do so would improve an adjoining estate more than his own.

Thirdly, the common plan adopted was to lay out a street 8, 9, or 10 yards wide, with a row of cottages built up to the street line on each side, back to back with each of these cottages was another fronting into an enclosed yard, the only access to which was by a covered passage on the ground level. Each owner had his yard, containing conveniences for the houses if there were any. If the owner had two houses only, one faced the street, and the other the back yard, the passage being taken from the size of the living rooms, the bedrooms extending over it. It might be that one owner might possess four or six cottages, but eight cottages in a ring fence formed a large estate. The yard was almost always enclosed, and as it frequently contained conveniences in a very filthy state, partly owing to the carelessness of the tenants and partly to the neglect of the Corporation officials, it will readily be believed that many, indeed most of these back houses, were unfit for habitation. It was the practice of the Corporation to let the cleansing of ash-pits, by tender, to the lowest bidder, who undertook to do the work for a sum for which it could not be efficiently carried out, and it was a common thing to see an ash-pit full to overflowing, the contents, containing filth of all kinds, escaping into the yard.

Fourthly, a very large number of cottages were erected without sanitary convenience of any kind. This fact is established by a reference to the Ordnance Survey of 1847.

Fifthly, when the Corporation began to pay some attention to sanitation, its action was most injurious, for it compelled a property owner to erect conveniences, although he had no suitable site, so that in one case they would be more than 100 yards away from the house; in another there would be joint ownership, leading to quarrels among tenants. In others, the conveniences would be in the middle of the street, it might be within 18 inches of the cottage door; while in one case that I know well, those for a whole row of sixteen houses and a bakehouse are in a cellar under the floor of the end house. In the majority of cases a house, or part of a house, was sacrificed, the conveniences being erected on the site of the living room on the ground floor, the first floor room remaining, and being used as a bedroom; separated only by its wooden floor from that which was beneath.

I am not speaking now of nuisances which were abolished many years ago, but of those which exist in hundreds of cases, to-day, although Leeds has had the services of a Medical Officer of Health for more than 30 years. I ought not to overlook the fact that the arbitrary action of the Corporation in times past has given rise to a feeling of hostility on the part of property owners, who, not unnaturally, object to be compelled to make expensive alterations at the bidding of the sanitary committee, and in a few years to have to incur further expense in abating the nuisance which they had been obliged to commit.

Sixthly, one of the most important points in connection with the old parts of the town is, that so many properties belong to life tenants, trustees, joint owners and absentees. This is a fruitful source of evil. A man buys a block of cottages. Whilst he lives he may look after them well, and though he be unwilling to undertake any expensive improvement, he probably keeps them in fair repair. When he dies, he may leave them to his wife for life, and after her death, they go to his children or grandchildren, some of whom are possibly living abroad. The rent collector, in these cases, is the only landlord the tenants know. He has no funds available for improvements, and in many cases is unable to carry out the necessary repairs. In cases of this kind, houses become absolutely uninhabitable—we should not blame the collector; if the owner does not care, why should the agent?

A few years ago, I purchased 28 houses, which were the subject of joint ownership, one of the owners being a medical man; four only of the 28 were occupied, but they were not fit for habitation. The money expended in making these houses habitable was little, if any, less than the amount of the purchase money. I could give many other illustrations of this kind, but I will confine myself to one only. Two houses of the kind recently referred to, that is to say, one fronting to the street, and the other into a yard, belonged to a man who died in 1864. He left them both to his wife for life. She survived him for 33 years, and when she died the front house passed by his will to a relative, but the persons to whom the back house had been left had disappeared, and there being no owner it speedily became a ruin.

Seventhly, another important fact which must not be lost sight of is that money prudently invested in cottage property returns a high percentage to the investor—the reason is fa obvious—it is that the number of pers desiring such an investment is limited. Th are disadvantages connected with the own ship of cottages which make many investors ject that class of security. I may be told tha it be true that cottages pay well prudent vestors will find this out and flock to the est market, with the obvious result that prices rise. This is not so for reasons that are cl to the careful inquirer. The ordinary inves who selects this class of security soon finds the evils which are inseparable from its own ship. Ere long the collector consults him as tenants who are in arrear—shall they be turn out and their arrears lost? or shall their fur ture be distrained upon? The latter cou may result in the proceeds being swallowed by expenses, and in either case the owner n have to listen to a long tale of grievances fr the wife. By-and-bye there will be a hi wind, which will strip a number of slates off blow the chimneys through the roof. Again rotten spout may fall and lame or kill a ch playing in the street below, and if these worr are followed by a notice from the sanitary autl rity requiring an outlay equal to six or, it m be, twelve months rent, it is pretty certain owner will determine to sell the property a never again invest money in such a securi It is well known that banking and life surance are profitable pursuits, but they c only be successfully followed on a large sca To insure lives is a business which yields good and steady return, to insure one life is most hazardous proceeding, so when a lar number of properties in various localities the subject of one ownership, all the risks spread and equalised, the difficulties are de with by paid officials and the capitalist h nothing to do but to receive his dividends.

Eighthly, various Acts of Parliament cont the erection of new houses, and compel t builder to comply with certain sanitary quirements. New houses, as a rule, are erect on land previously unbuilt upon, and t builder does not carry on his operations fr philanthropic motives. He builds for the sa reason which induces a butcher to sell me His object is to make a living, and if he co make only 2 per cent. on his money he wo cease to build houses. Whether or not operations are profitable, depends on the r which he receives, in the fixing of which he l to obey laws over which he has no control. he charges too high a rent his houses rem empty, while if the rents do not yield a f

ırn on the capital invested he ceases to ld.

Ninthly, there are many well meaning pers who ignore these facts, and who do not sitate to recommend the sweeping away of old buildings and the erection of modern ellings on the site. These persons do not lise what the result of such action would Before they can pull down an existing ıse they must buy it, and the purchase ludes land and buildings. Each £100 ıs invested may be taken to represent £20 rth of land, and £80 worth of buildings. hen the building has been pulled down the d only will remain, but it will have cost oo, and the house to be erected upon it will ve to compete with a similar house, standr on a £20 site. In this connection, have to deal with the possessor of ıt very dangerous thing "a little learning" o hastens to assure us that no difficulty of s kind can arise, since the new houses to be cted on expensive sites will be erected by municipality, with money borrowed at er cent. or less, and if the builder expects er cent. for his investment, the municipality n afford to let at 2s. 6d. a week a house nilar to one for which the builder gets 5s. very little reflection should satisfy us that is is not sound argument.

It is unfair that the municipality should ter into such competition with the ordinary ıder. It would be as reasonable to propose at it should open a butcher's shop in every or neighbourhood and retail to the poor ime joints at 4d. to 6d. a lb. It surely will t be seriously suggested, that of two working en living in similar houses, one should pay . 6d. a week rent and the other 5s.! Oh! ıt says my critic, who talks without thinking, e Town Council will only let their houses to ople who cannot afford to pay more than . 6d.—to the people in fact who formerly cupied the houses pulled down. How can is be carried out in practice? The only plan can think of is to brand each evicted tenant, en, when the Corporation agent asks 5s. a eek rent for a house, and the applicant says can only pay 2s. 6d., he will be asked to ll up his sleeve and show his tattoo mark! d what is to be done when there are no plicants entitled to occupy on payment of lf rent?

The Leeds Corporation have recently carried t an admirable scheme, under the "Housing the Working Classes Act," of which I shall ve to speak by-and-bye. The Local Government Board compelled them to erect 10 new houses for the tenants whom it was necessary to evict in order to carry out this scheme. These were erected on vacant land a quarter of a mile from the area to be improved, and were immediately let at rents ranging from 5s. 9d. to 6s. 3d. per week. It is needless to say that none of the tenants had previously lived in any of the houses which it was necessary to pull down.

There are other circumstances which combine to make the wholesale clearance system wasteful and expensive. The existing streets in slum districts are of less width than the minimum which the law now allows, so that when the site has been cleared, it must be laid out afresh, involving the cost of forming paving and sewering new streets. But I shall be told that what I call impracticable has been successfully accomplished, and Corporation-street, Birmingham, will be referred to. I understand that the making of that improvement was part of a thoroughly successful scheme, because a wide street was needed, where there had been slums and narrow alleys, and the value of the frontage to the new street was many times the value of the land and buildings which had to be purchased. Land abutting upon Corporation-street, Birmingham, is no doubt very valuable, but it is only the very ignorant who suppose that wherever you make a wide street the land fronting to it will be very valuable. What then, I may be asked, do I recommend? What should be done when there are too many houses on a given area? I say, follow the example of the gardener and the woodman. When a gardener sows turnips, he invariably sows too many seeds, I suppose because the seed is cheap. When the plants begin to grow, and he finds ten growing on a space where one only can mature, does he pull them all up and sow again? No, he weeds out the superfluous ones, just as the woodman fells the superfluous trees, selecting those that are weakly, or otherwise unlikely to improve.

I have occupied some time in describing some of the lessons which I learnt, and I think I have not been wasting yours, for I feel satisfied that anyone who desires to deal successfully with the great problem of the housing of the working classes, will have to learn sooner or later the lessons I learnt, and the sooner that is done the better. The circumstances may vary in detail, and I readily admit that the position of matters in the metropolis differs materially from that in any provincial town, but the same causes are at work everywhere,

and, with certain modifications, must produce the same effects.

The result of my enquiries was, that I advised my friends to purchase existing houses, in the old parts of the town, and in the year 1876, two properties, comprising 40 cottages, were purchased; the rents were collected by ladies, and the result was thoroughly satisfactory. I had by that time become a shareholder, and I did not fail to urge the purchase of additional properties, and when I found that the hon. secretary was unable to undertake the additional labour which this would entail, I undertook the post of hon. secretary myself, which I held for ten years.

The company now has a paid-up capital of £70,000, a reserve fund of £3,000, and owns 1,000 houses, standing on more than 14 acres of freehold land. If I had had my way, these figures would have been multiplied by 10.

The progress which has been made, has been made in spite of opposition, almost every conceivable obstacle having been encountered and overcome at one time or another. I well remember one shareholder proposing that the company should be wound up because there was no longer any need for its operations. The jerry builder, said he, builds admirable cottages in the outskirts of the town, and that is all we require!

Of course any thinking person would see, in a moment, that to build good cottages in the outskirts could not improve the central slums —but, as the objector was a clergyman, who had worked for nearly half-a-century in the worst part of Leeds, the objection appeared to have some weight. Again, it was said that the work of the company was experimental, that it was a toy—depended for its apparent success on two or three philanthropists. The brokers would not look at the scheme. Many objections were made to the way in which the accounts were kept, by people who did not realise that it was not a trading company—and people who had money to invest, declined to take shares, for fear their executors would not be able to sell them.

The directors were timid, out of every ten properties which came into the market, seven or eight were rejected for some reason or another. One property was too good, another was too bad, another was for sale by auction at a time when the company did not happen to have sufficient un-invested capital.

In spite of all these obstacles and many others the company has achieved success. Its operations can no longer be regarded as [ex-]perimental, and I am anxious that similar w[ork] should be undertaken in every large centr[e of] population. Special attention has, fortunat[ely], been directed to this subject in recent yea[rs], and Parliament has on more than one occas[ion] endeavoured to deal with the matter. So[me] recent legislation has been useless or injuri[ous], but the "Housing of the Working Clas[ses] Act, 1890," is capable to leading to very go[od] results if its powers are put in force by in[tel]ligent persons.

I will shortly explain two schemes under t[he] Act, recently framed by the Corporation [of] Leeds. One of these, called the "Ca[mp] Field" scheme, is in every way admira[ble]. "Camp Field" is a district about two ac[res] in extent, of which I have a plan, showing [the] area before and after improvement. The p[lan] adopted here was the same as that of [the] woodman with his trees. Of about 200 hou[ses] which stood in the area two years ago, 5[0 or] more have been removed. These are colou[red] blue on the map, the remainder have b[een] made habitable, confined courts have b[een] opened out, filthy conveniences removed, a[nd] the place is now a credit, as it was a disgra[ce] to the town. The total cost of this w[ork] was estimated at £4,700 and will proba[bly] not exceed twice that amount. The ot[her] district, called the York-street area, is a v[ery] different one, and it has been dealt with [in] a very different manner. The procedure [as] regards this part of the town has been [as] follows:—The Medical Officer has condem[ned] an area covering 75 acres, of which about o[ne-] fifth ($16\frac{1}{4}$ acres) has been dealt with unde[r a] scheme. This area includes some very [bad] houses and many good ones, much better th[an] any in "Camp Field." All have been c[on]demned, good and bad alike, and the C[or]poration are now acquiring the proper[ty] under the "Housing of the Working Clas[ses] Act," and it is said they intend to clear [the] whole site, but it is to be hoped they will [not] be permitted to do any thing so monstro[us]. Before the scheme was approved there wa[s a] local enquiry, which should have been a co[urt] of law, but instead of being presided over b[y a] lawyer the Judges were two Governm[ent] officials, the one a doctor and the other [an] engineer. It was obvious that the enquiry [was] a mere matter of form; the decision hav[ing] been previously arrived at; the proceedi[ngs] were a farce, which would have been lau[gh]able had the matter not been so serious. Ti[me] will not permit me to mention more than

cumstances for the purpose of showing the surdity of the proceedings. The Town Clerk peared for the promoters, and opened the ceedings with an able speech, the effect of ich was entirely spoilt, because the Judges de him speak so slowly that they could te down all he said. Anyone with an mentary knowledge of legal proceedings ows that the opening speech is not evidence. s a preliminary statement to give the Court idea of what it has to deal with. The Town rk, being a lawyer, knew that the Corporation were not entitled to their order, unless y proved that the district was unhealthy, defined by the Act; so he stated, in his ech, that the area was unhealthy "from l to end, and through and through." The lges took down this statement, but asked for evidence to support it. The Town Clerk e no such evidence because he could not so, and when I cross-examined the Medical cer as to the truth of his statement he was ged to admit that it was slightly rhetorical. f I mention one other fact it will be sufficit to show the nature of the scheme under ch the Corporation are compelling people urrender their properties at less than their rket value. A large corn mill within the a was excluded from the operation of the eme, but a piece of bare land belonging to mill owner, and necessary as giving access his mill, was included. The explanation en by the Corporation witnesses was that en an adjacent highway had been widened, frontage to it would not be deep enough to readily saleable without the land in ques-, showing that the scheme was not a itary one at all, but a street improvement eme for the purpose of which the Corpora- desired to acquire property cheaply by ing it unhealthy. They wanted to make k-street, near which the mill is situated, e enough for tramways, and to have suffit land on each side of it for the erection of ortant buildings; in order to secure this called a piece of vacant land unhealthy!

he "York-street" scheme is as bad as the amp Field" scheme is good. It does not ear that, in the preparation of it anyone uainted with the subject of sanitation was sulted. It is believed that it was prepared he Medical Officer of Health and the City ineer. Perhaps it is unfair to blame the poration for the mistakes that they have e, seeing that they have no expert guide his matter, but there is a common error h must be pointed out.

It seems to be assumed that the housing of the working classes is a question which should be dealt with by a medical man: no greater mistake can be made. If you must have a medical officer of health, limit his sphere of operations to subjects with which he is acquainted. He will have plenty of occupation in dealing with germs, and microbes, and bacilli, and looking after infectious diseases, bad meat, &c. To be skilled in the housing of the working classes two qualifications are necessary—commonsense and a knowledge of the needs and habits of the people with whom you have to deal. Under the head of commonsense, I would include the rare habit of ascertaining the facts first—by a scrupulously impartial inquiry—and afterwards forming conclusions to which those facts lead. The person to be avoided more than all others is the faddist! He has wasted vast sums of money. Many years ago, the sanitary authorities in Leeds—under the advice of their medical officer—compelled the property owners in a large area to provide, at their own expense, conveniences of a certain pattern. These, owing to the neglect of the same authorities, caused an intolerable nuisance, and, after many years, the owners were compelled to incur further expense in undoing the mischief which they had been forced to commit. I must refer again to the York-street scheme. You will remember that the scheme was designed by a doctor and an engineer, and tested by a tribunal consisting of an engineer and a doctor! It does not comply with the provisions of the Act of Parliament under which it professes to be made. An unhealthy area is defined by that Act as one with narrow, close, or badly arranged streets, which "cannot be effectually remedied otherwise than by an improvement scheme for the re-arrangement and reconstruction of the streets and houses." Please note all those words. Such a scheme the Corporation was bound to make, and it must provide proper sanitary arrangements, and be accompanied by an estimate of cost. The one which the Corporation did frame provides for no re-arrangement or reconstruction, nor any sanitary arrangements whatever, and the estimate is not of the cost of improvement, but simply of the purchase and destruction of buildings.

On the wall behind me is an Ordnance map of the area, showing how I would deal with it. I would do as the Corporation has done in Camp Field, and remove the buildings coloured blue. The remaining buildings would be fit

for occupation, would accommodate a large part of the present inhabitants, and would let at rents whlch they could afford to pay.

If the area be completely cleared, any dwellings that may be erected on it must comply with modern regulations, and command high rents; and if that system be adopted on a large scale, the city will be saddled with an enormous debt, and a monstrous injustice will have been done to the poor people. Two or three families will have to live in one house, and as they will carry their habits with them, the last state of that area will be worse than the first. Wholesale and sudden changes are not practicable. It is only on the pantomime stage that the waving of a wand can turn a pumpkin into a gilded coach. My rule is, remove the superfluous houses, improve the remainder, and by so doing improve the habits of the tenants.

The small map on the wall is intended to show how small is the area dealt with. Sixteen acres out of a total of 21,572, the York-street area, is coloured red on the little map. The scheme for the York-street area is dated 1895, and not a house has yet been touched; and as the Local Government Board control everything, there will probably be much more delay. It is said that no one who has not had dealings with that department knows what "red tape" and "obstruction" mean.

Leeds has some experience of clearing areas, by the wholesale destruction of buildings. More than thirty years ago, the Corporation purchased a considerable one, which was covered by wretched dwellings, and they at once cleared the whole site; some time afterwards, a police-station was erected on part of it, and, more recently, baths on another part, the rest of the land is bare of buildings to-day, though the Corporation have more than once tried to sell it.

I must describe to you the East King-street area. A plan of it is on the wall behind me, and a model is on the table. It is a parallelogram, 63 yards long by 54 yards wide, and contains an area of 3,400 yards. On this site there stood, when my model was made, 88 dwellings, forming 23 properties, owned by 21 owners, one of whom owned one house only while six others owned two dwellings each. Each property is distinguished on the map by a letter. The two houses marked A belonged to the owner of an adjacent public house, who lived 28 miles away. The owner of E was a lady bearing a foreign name and living abroad. I had a great deal of trouble in tracing the owner of two houses, marked F, which had been unoccupied years, and had both doors and windo boarded up. I ascertained from an old ra book that they had belonged to a clergym whom I traced to a living in Herefordshire. wrote to him, but he died before my le arrived, and his representatives wrote to for information about the houses—of existence of which they were unaware. T owner of O—one house—was a gentlen living at a park in Kent. Three cottag marked R, belonged to a poor woman, w occupied one of them and lived on the re of the other two. The Corporation requi her to make an outlay on sanitary impro ments, which she could not afford to do, the Corporation did the work and entered i the receipt of the rents; consequently, hav lost her only means of support, she diec starvation! A female had also been owner of U, but she had died intestate, as there was some uncertainty as to who entitled to the property, I found an en prising Irish labourer living rent free one of the cottages. The five hou marked I belonged to a well-known spea at religious meetings. The owner of was a well-known Magistrate, whose has since been proved at a quarter o million! The district was known to the polic the abode of the worst characters in the nei bourhood—indeed, the collector of one of properties told me that he had to keep tw the houses empty, because he could get no but thieves or other immoral characters to in them. My idea was, to deal with the s as the Camp Field area has since been d with, but the Corporation purchased houses and pulled them all down, so that land they stood on is now waste. I think I the first to call attention to this area—ind the sanitary committee had my model be them when they decided upon their schem destruction; and what has been done in Ca Field is what I had previously advocated report which I had presented to a sani association, of which I was a member.

More recently I called attention in the P to the grossly inadequate provision of veniences in certain districts—instancing cottages, which belonged to the family late alderman, and which had no convenie whatever! The Corporation have since ta vigorous action in this matter, by compe cottage owners to do their duty in this resp They are, however, only putting in force po which have been allowed to remain dorm

years. I have spoken hitherto of Leeds, I wished to state facts within my own wledge, but I shall have failed altogether iy purpose if any of my hearers are under impression that what I have said relates to ds only. The same causes usually produce lar effects. The position of matters in the ropolis is complicated by the existence of ding leases, of which we, in Leeds, fortuly know nothing; but I firmly believe, what has been done in Leeds, on a small e, by the Industrial Dwellings Company, be done in London on a large scale, and even better results. The subject is one h is now attracting very general attention, I ought not to omit to refer to an Act of iament recently passed, enabling municipal orities to lend money to working men, to them to buy or build their own cottages. loubt it is a good thing to induce thrift; obligation to make periodical payments rds the purchase money of a house will ce a man to save money which he would rwise spend, but I believe the Act to be atesmanlike, and calculated to have ious effects. It is unstatesmanlike, be e it would make the municipality under work outside its proper sphere—work, over, which can be and is done better by ling societies; but there are more serious tical objections. Suppose a thrifty, young an who has saved a little money, and is king of marrying, determines to buy a e, and so be his own landlord; for some s a two-roomed house is all he requires, perhaps is all he can afford. As he grows his position improves, and his family ases. He needs more room, but he has ht his house, and for many years to come istalments of the purchase money to pay. n, when he dies, there are further comtions. He leaves the house to his widow fe, and, it may be, necessary repairs are cted. When she dies, the children take shares, and frequently there are disanents amongst them, one wanting to sell another wishing to keep the property. over, a workman has frequently to move a new neighbourhood, and in that case is usly hampered by being the owner of a e, only partly paid for.

fore I leave this subject let me call your tion to the plan behind me. This shows v of 18 back-to-back cottages, which I well. Each colour on the map represents arate owner. They were built more than a century ago by a number of working men, each of whom bought a plot according to his means. At that time conveniences were not considered necessary. The original owners are all dead, and it will be readily understood that sanitary improvements are almost, if not quite, impossible. When I last inquired one of the owners was in a lunatic asylum, and the Poor-law Guardians received the rent on account of his maintenance.

I hope I have not wearied you by speaking so much about Leeds. I felt that my first duty was to show that I was acquainted with my subject, and really it matters little—in dealing with it—what large town is selected as an example. As regards London, I presume I need not waste your time by inquiring whether it has any slums which need improvement? So I will devote the remainder of the time at my disposal to a brief explanation of the mode of improvement which I recommend. There probably never was a time when there were more charities than there are at present. Organisations exist of many kinds, for enabling those who have more money than they need to assist those who have less. These are of various kinds—religious, medical, surgical, educational, reformatory, and many others. It is said there is only a certain income available for all these; and that if a new charity be started, it obtains its income at the expense of some older organisation. All these organisations are alike in one respect, that whatever money they receive from the public they make no return for it in the way of dividend. If it were required to select two mottoes applicable to every one of these organisations they would be the following:—"Supported by voluntary contributions" — "Funds urgently needed."

I do not propose to compete with any of these: and so far from being antagonistic to them I contend that my scheme would inure to the benefit of all. I think it will be sufficient proof of this to quote a few words uttered not long ago by a well-known clergyman than whom few are better acquainted with metropolitan poverty and crime. He came down to Leeds on a tour of inspection and I had the privilege of showing him some of our choicest specimens. I quote the following sentence from a lecture which he afterwards delivered on the subject:—"With regard to the places which I have visited I do not hesitate as a clergyman to say that to speak to the people living in such places about decency, sobriety and religion, is a mockery."

There are many companies which are

already dealing with the housing problem. Most, if not all of these, are engaged in building operations, and those which are best known adopt the plan of erecting buildings in flats in the place of two or three storied houses. This system is open to objection to which, however, it is not my province here to refer. I will only say that if tall blocks of flats are necessary in London, the company which I wish to form would be well able to erect them, for it would acquire the necessary sites for a reasonable outlay, since it would buy only that which was in the market. My proposal may seem at first sight to be a somewhat audacious one, for I do not require the gift of a single penny. I would make use of the millions which are always waiting for profitable investment, and would return to every subscriber a substantial and well-secured interest for his money. I propose to purchase existing dwellings as they come into the market, and gradually to improve them. In this I ought to have the support of everyone interested in the welfare of the people.

I have already explained why money prudently invested in cottages pays a high rate of interest; and in dealing with the question as applied to the metropolis, one must not overlook the gradual increase in the value of property. I say gradual advisedly, for the growth is seldom rapid enough to attract the speculator; but in the course of years the increase in value will be very considerable. That is why I advocate limiting the rate of dividend, lest at some future time the shareholders should decide to treat too large a proportion of their earnings as income, and overlook the improvement part of the scheme.

Another important point to be borne in mind is that the acquisition in one hand of contiguous properties now having several owners, will render improvements easy of accomplishment which would otherwise be difficult or impracticable.

I hope to have the support of all who are interested—and who is not interested?—in the improvement of the metropolis. Much has been done in recent years. We spend vast sums annually in educating the children of the poor. We have cheap newspapers, free libraries, museums, parks, and so forth; but the most important thing, the improvement of the home, has not been attended to.

It may be taken as a general rule that as the house is, the tenant is. If you improve the tenant, you will not improve the house, for he will go to a better one, but if you improve the house, you improve the tenant and his wife children. If any one who is specially intere in any particular line of improvement, is posed to regard my scheme as antagonisti his pet plan, I would like to ask him i will venture to assert that the ploughman i enemy of the farmer. The farmer does send the ploughman away, for he knows whatever crop he is going to sow, he will a better return after the ploughman prepared the soil.

All I want is money for the plough and harrow, then I will welcome the farmer, stand aside so that he may sow his c feeling sure that whatever seed he sows it be ten times as productive if it falls upon ground.

Now the slums of London produce flouris crops of poverty, crime, disease, and mi I propose to plough the land, and clear weeds, for whoever improves the dwel must improve the people living in them. I new scheme must meet with objection think I have dealt, in my time, with conceivable objection to what I propose, suppose it is only human nature to say what you recommend has not been done be and therefore it is impracticable. That ca longer be said of my scheme, which has in successful operation, on a small scal more than a quarter of a century.

I will here deal with one objection, wh have frequently had to refute. I have told that I am mixing up philanthropy business. If I am, I am not the only p who has succeeded in raising capital wit object of doing good. Years ago, the m facturing districts of Yorkshire and cashire suffered from inadequate railwa commodation in their communication their principal eastern seaport, Hull. investor and his advisers are not reasoners. They argued thus—a new ra to Hull is much needed, therefore it wil The result was the incorporation of Barnsley, and West Riding Junction Ra and Dock Company, which has now a capital of more than three millions ster worth to-day one and a half millions. money thus lost had been invested c plan it would have earned a steady cent. dividend, re-modelled Leeds, reduc rates, and half emptied the gaol. The sunk in the Manchester Ship Canal migh done similar good to Liverpool and chester; and yet it was eagerly subscrib people who wished to benefit the latter ci

ıeme is sound, and will pay, it ought not an objection to it that it will also do good. could easily continue this paper until, aps, your patience would be exhausted— ime has obliged me to leave much unsaid. w me, in the few minutes remaining to me, plain as shortly as possible what I propose. ıt is the position? There are in London lreds of thousands of houses unfit for tation. May I assume that we all want to be made decently fit for people to live I assert that a house is not fit for tation unless it possesses the five following isites:—

Sufficient pure air.

Sufficient light—I should like to say hine.

Sufficient water for household purposes.

Provision for the removal of refuse.

Shelter from the inclemency of the her.

a house is deficient in all or any of these gs the cause may be one of the following:—

) Irremediable defects—that is, defects of truction.

) Remediable defects—that is, want of ir.

London, the difficulty in dealing with e is enormously increased by the existence uilding leases. If a 99 years' building e has but 10 or 15 years to run, it is not asonable to expect that the houses held r it are defective. The leaseholder is rally disinclined to spend more money than ecessary on repairs; while if the defects e under Class A he will not unnaturally be illing to spend his money in permanent ovements—the benefit of which will shortly enjoyed by the ground landlord. My dy then is simply this. Form a company ample capital, purchase the properties hey come into the market, buying both holds and ground-rents, attend at once to nt repairs, and as opportunities offer, e structural improvements. The nett me will be sufficient for the accumulation substantial reserve after paying an ample lend on the capital. There are several ers which should be attended to in the ıation and management of the company.

Let the directors be well known as thohly practical men. Rigidly exclude all rists and faddists.

Let the rate of dividend be limited by Articles of Association, so that there may no risk of future profits being wasted in ng high dividends. The object of the promoters should be to attract, not the money of the speculator, but that for which a reasonable and steady interest is required. I purpose calling a meeting of all who are interested in this subject on an early date. I will gladly receive any names and addresses to-night, but no one will be committed to anything by giving in his name, or by attending the meeting. I will wait a few weeks for the names of any who, though not present to-night, may be interested in the subject after reading this paper when it has been printed.

I have only to add that I hope for the hearty co-operation of a sufficient number of persons to secure the successful starting of the undertaking. I have no fear with regard to the future. Shakespeare says of the quality of mercy that:—

> "It is twice blest,
> It blesseth him that gives and him that takes."

I propose to offer a good investment to the investor, and, at the same time, to benefit those who cannot help themselves. Help me all who can, so that I may feel that I have accomplished a little "before I go hence, and and am no more seen."

DISCUSSION.

Mr. JAMES PARSONS desired to thank Mr. Wilson for the very careful and detailed paper he had prepared, and for the suggestions he had made. He could endorse a great deal of what had been said, but the two points he wished to lay most stress upon were these: firstly, that this was to be looked upon as a business matter, and should not be allowed to get into the hands of any people who wanted to make others live in the way they thought right, instead of providing for them such accommodation as they really needed. The question of housing should not be regarded apart from the general conditions of life, because, though the house was a most important element, still it was only one out of many, as for instance, the amount the people could afford to spend on rent, having regard to the other claims upon them. It was no use spending large sums in providing dwellings which did not meet the needs of the people whose economic condition gave rise to the difficulty. The other point, which really lay at the root of the matter, was a question of management. The houses Mr. Wilson had described were owned by a great variety of people, and, consequently, any common system of management was impossible. They should be so managed as to be fit for the habitation of civilised people; and in large towns, where there was such close contiguity, that necessitated some kind of common management, otherwise

the lives of some people would be rendered miserable by the doings of their neighbours. The management must be strict, but, at the same time, sympathetic; rules should be made, not for the purpose of interfering with any one's freedom, but simply in the common interest of all. He was not sure that he should condemn the leasehold system so strongly as Mr. Wilson had done: it had, at any rate, one conspicuous advantage, that at one and the same time a large quantity of the property in one neighbourhood could be dealt with. Towards the end of a lease there was a chance of getting hold of a block of property in a dilapidated condition, which could either be demolished and rebuilt or, as was suggested, repaired and improved. He thought immense patience and perseverance must have been exercised by Mr. Wilson in getting hold of so many little properties held under so many different titles. Of course, it was to the interest of the ground landlord that the property should get into the hands of respectable people. The great question of overcrowding could only be dealt with by a good system of general management, which would not allow such overcrowding to take place. It was only by a development of the public conscience that many of the evils under which we were now labouring could be removed.

Mr. Wallace Bruce said he was a member of the London County Council, but he hoped he was not a faddist. The great difficulty in London, which Mr. Wilson had not dealt with—and he did not see how his remedy would touch it—was over-crowding. In the central parts of London there were five, six, seven, and as many as ten people living in a single room, and that not in single instances or hundreds, but in tens of thousands. The cause of this was that so many people wanted to live near the centre, and land there was too dear to be lived upon. It was worth for factory or business purposes three times as much as anyone could afford to give for it to build houses upon, which could be let at reasonable working-class rents. He knew an instance near the City boundary where the County Council would have paid £10,000 for a piece of land for dwellings, but it was sold for business purposes for £30,000. The consequence was that people who ought to occupy three rooms lived in one. Such a large portion of the rent went for the land that there was nothing left for the house itself. When they thought of the various slums in London, he did not think the remedy of pulling down a house here and there would help them much. In the Drury-lane district there were 2½ acres, a family living in almost every room, and the only convenience being in the cellar—no back yards at all, the only access of air being by a narrow court. If a few were pulled down the insanitary conditions of the rest would remain much the same; there was nothing for it but to sweep the whole away and rebuild. It was much the same with many of the alleys out of High-street, Southwark. The demolition and reconstructic the areas was very costly, and the problem was it could be done in a less expensive way, than u the Housing of the Working Classes Act. seemed to him the only remedy was to make owner of the land responsible for the houses up being fit for human habitation. At preseut the la not seem to hold the owner of the land responsil any way. In St. Pancras there was an area, one of which was owned by a noble lord, and the oth Lady Henry Somerset. The latter expressed desire to act with the London County Council said if they took the property compulsorily and celled the leases, she would rebuild, but the lord on the other side declined to do so, and County Council had to do it themselves. Lady H had to go to the Court to get permission, be other persons had an interest in the property, an Court held that the only thing to be considered what would produce the highest rent, and prev her doing what she proposed, so that the whol pense was thrown upon the Council. He thoug that respect the law required alteration.

Mr. James Walsh was of opinion that the v difficulty arose from the greed of capitalists ing to get the highest possible interest for money, and that the only remedy would be fo County Council or municipality to undertake the vision of dwellings for the working-classes. Guinness Trust, Peabody Buildings, and other wanted interest on their money; and though well-meaning people might be satisfied with a per-centage, they did not live for ever, and there no security that those who came after them woul raise the rents to increase the dividend. He of a case in which a woman, who had been payin a week, had just received a week's notice th future the rent would be 14s. Under muni management they might feel secure that the would not be raised in this way.

Mr. S. S. Bromhead agreed with the pre speaker that the measures proposed by the r of the paper, though probably sufficient f provincial city like Leeds, would be quite adequate for a city with a population so as that of London. If, in London, we wei have any scheme at all, he thought it must in some measure for carrying people out beyond present limits of London, and affording them sp railway facilities at an extremely cheap rate. schemes of the kind had, he knew, been devised although personally he would wish all success to Wilson and his proposed company, he could not thinking that such a proposal was merely tink with a vast and important question. With refe to the remarks of Mr. Walsh, that gentleman app to have totally misconceived the object of the Gui and Peabody Trusts, which bodies had endeavouring to grapple with the question on a scale. Mr. Walsh seemed to be unaware that n

ness nor the Peabody Trust paid interest. The y was given freely both by Mr. Peabody and the nesses and as the rents were received fresh build- were erected so that the benefit derived was antly increasing. But notwithstanding that, he d that we wanted also in London the assistance County Council or some other great body which buy up a large quantity of land ten miles from entre of London and lay it out in a sanitary er, form roads, erect dwellings, put up laundries vashhouses and every other accommodation, and construct a line of steam tramways or some such s of communication which should convey the popu- at an extremely low rate, say 2d. daily return or ess rate than that by the week. Nothing short at would deal effectively with the difficulty. was room in all parts of London to improve rty in co-operation with the trusts now at work, e sincerely wished the movement every success.

. WILLIAMS said it had occurred to him that ing to the reader of the paper was like reading a pages of the report by Sir Edwin Chadwick, shed in 1842, and it would seem that since time we had not moved much. The problem solved was the housing of something like 0,000 working people; taking the whole of country, and reckoning the people who were of room, it would probably be found that there as many as that. There were quite 2,000,000 ondon, and there were probably 10,000,000 or 0,000 more throughout the kingdom, including d and Scotland. How was it that things had to this pass? Why was it that there are as people in London to-day as the whole of the itants of Leeds living in one-roomed tenements, numbering in these tenements from one to teen? He would like everyone to consider the and wherefore of our present position. He glad to hear that people in Leeds did not flats. They did not like them in London; nevertheless, we were building them. At al-green, the County Council had inaugurated eme under which it was proposed to house per acre, and he would like to hear from the r of the paper what he thought the number d per acre should be. Then it was found that uld not pay to do that, so they had had to clap nother storey, and now they housed 315 to the The number per acre throughout the whole of on was 158. There was another scheme at nk, where they were putting 527 to the acre, Wilson had suggested that we should have houses—an admirable suggestion—and that we d take some down, which, of course, meant people to the acre, and more air spaces, but if we rom 500 to 600 people per acre, no matter how ifully the buildings were designed, he prophesied he result would be that when those buildings had occupied for twenty or thirty years there would be more slums to be cleared. It was said that the cost of the land was enhanced by the necessity of buying the buildings standing upon it. But why was it necessary to buy these insanitary houses? When a house had become insanitary, it was a nuisance, and ought to be cleared away by the owner. He would go further than Mr. Bruce, and not only make the landlord responsible for the condition of the house, but also make it incumbent on him to clear away the slums which were a nuisance and a danger to the community. It was curious to note that in London but few of the old tenants occupied the new buildings. In Bethnal-green the proportion was only 11 out of 1,500. He agreed with Mr. Wilson that medical officers and officers of health should be limited to their special duties. A medical officer, for instance, had no business with the question whether improvements would interfere with private enterprise, his business was to do the best he could for the Council and for the public, and the same with the architect. He was glad to hear Mr. Wilson's suggestion that common sense should be brought to bear on the subject, and he would suggest one more thing, namely, sympathy. If we did not count the people as one with ourselves we should never do any good. He objected to the term "housing of the people," as if they were so many cattle. Mr. Wilson's proposal showed between 400 and 500 to the acre, there being 88 tenements and five to the tenement. He agreed with Mr. Wilson that that was a most sad case where the Corporation having done the repairs collected the rents and left the owner to die of starvation. With regard to building leases he contended that they had been the bane of London. Nearly the whole of London was on the leasehold system, one of the most monstrous systems that ever came into existence. Leases were constantly falling in, and large sums were paid for renewal. The Duke of Westminster, in particular, exacted tremendous fines, and it was impossible for many tradesmen to make a living when they had to renew their leases. With regard to men buying their own houses, we had had an instance of that on the Shaftesbury-park Estate, which was started with the best intentions some thirty years ago. The idea was that working men should become tenants and at the same time buy their cottages. Many did; but to-day nearly the whole of the houses had gone back to the society, and he was told by one of the directors not long since that they were trying all they could to buy them all back. The thing had been tried and failed, because the workmen were constantly moving about. He agreed that the municipality was the proper body to provide houses.

Mr. BRUCE said with regard to the dwellings erected by the County Council in the Boundary-street area, the height of the houses was the width of the street, and behind there was a space double the width of the street for the children to play in. There was also a public garden and two other gardens, and the idea of fifteen acres of buildings of this character

becoming a slum again in the course of a few years was absurd.

Mr. Wilson, in reply, said that the subject with which he had had to deal was a very large one, and he had carefully guarded himself from going into side issues. One speaker asked how it was that there were so many people for whom dwellings had to be found. It was because there were so many people crowding from the country into the towns. If they could be got back, we should have as many people as were wanted in towns, and no more, and then wages would rise. With regard to the gentleman who wanted to have rents fixed, perhaps he would like to have his wages fixed in the same way. Mr. Parsons spoke in favour of the leasehold system, because it was very convenient when the leases fell in, but if the property were bought out and out they need not wait until the leases fell in, it could be dealt with immediately. If it was necessary to erect large blocks of buildings in London, surely a company could do it better than anybody else. He did not think it was a thing that the municipality ought to do. It could of course do it, as it could do all the butchering and bakering for the community, but he did not think that would be a good thing. What he had suggested might not do all that was wanted, but he certainly thought it would do a good deal. With reference to high rates of interest, he had particularly provided against the possibility of such a thing. The dividends should be limited by the articles of association, so that there should be no risk of the rents being raised in the oppressive way suggested. He should be very glad to hear of a million or so of money upon which no interest was required.

The Chairman, in proposing a vote of thanks to Mr. Wilson, said he was in no sense an expert in this matter, but he had been very much interested and gratified by the paper, which bore out very much what Mr. Wilson had said as to the application of common sense to facts which had been carefully investigated. But probably no one would be more willing than Mr. Wilson to suggest that precisely the same methods as were adopted in Leeds would be applicable everywhere or to a place like London. Mr. Wilson had investigated the subject locally, and other local conditions would make other methods necessary.

The vote of thanks was carried unanimously, and the meeting adjourned.

Miscellaneous.

MANUFACTURE OF TILES IN PERSIA.

The manufacture of porcelain, glazed, and encaustic tiles dates from a very remote period in the history of Persia. Tiles have been excavated in their a original lustre from the buried cities and ento palaces of Babylonia, Persia, and Media, an now among the treasures of the museums o West. The United States Vice-Consul at Te says that tiles in their pictorial aspect have con able variety of form and representation. In instance a tile contains a complete picture, wh another it may form a small section of a large co sition. In the earlier stages of the art, the surfa the tiles appears to have been generally smooth flat, while in later developments raised or emb figures have entered largely into the design, espe for mural and frieze ornamentation. The æst idea was generally modified to represent the char the predilections, and the policy of the rei monarch of the period. Warriors in complete arn hunting, feasting, and at religious devotions diver the illustrative scenes. In the superiority of mate in the delicacy of design, in the beauty of colo and perfection of finish, nothing has perhaps equ the work of the 13th, 14th, and 15th centuries o Christian era. The tiles produced during this p were generally devoted to the decoration of mos holy places, shrines, and tombs of saints of Mohammedan faith. The centre is compose flowers or geometrical figures, and the border co of written passages from the Koran. A golden pervades the whole surface, sometimes united wi shade of blue, giving to the design a peculiar sof and charm. The materials and the method of ducing this characteristic are now unknown, hitherto no attempt to reproduce it has successful, either in Persia or Europe. tile manufacturer in Teheran, after experimen for many years, according to the Vice-Consul, se to be on the path of success. How this beau art was lost to the world is often asked but wit eliciting any satisfactory answer. It should be n that vessels of household use, especially vases, ev basins, and dishes, were made of the same mate with the same glow and tint of colouring, but h more delicate in texture and more fragile in f very few examples remain. At the present t two classes of tiles are made—the plain and picto the former in a variety of shades for flooring, an latter chiefly for mural decorations. As a ger rule, tiled floors consist of alternate white coloured rows, though some are laid in comp designs. The masonry of the gates of Tehe the domes of mosques and shrines, and some pu buildings are overlaid with variegated tiles arabesque or mosaic designs. The effect is gr ful though decidedly oriental. The thicknes the tile varies from two-thirds of an inch to t inches. Those used on the outside of build are the thickest. The material used in the c position of the ground work consists of n tenths of pulverised quartz to one-tenth of stro adhesive clay, and the glazing is compou of flint and potash. All the minerals use

ıanufacture of tiles and porcelain for ground-glazing, and colouring are found in the ry. With our preconceived notions of com-ed manufacturing process, it is difficult to ıe that the most beautiful carpets in the world e product of the gipsy's tent, or that the glow-rface of the ornamental tile can have received ıpe, colour, and hardening in a mud hut, with no machinery than a pestle and mortar and an ıry knife. No sanitary laws exist for the tion of the workshops, or even a general in-on of the conditions of living and habitation. s respect every man is a law to himself. The ll continue to be used as a covering and orna-for the domes, cupolas, and minarets, both and outside of mosques and other sacred ıgs; but for houses and public buildings it to be gradually falling out of the taste and n of the times, and giving way to simpler and er materials. For durability it is superior to ng now in use, but the cement by which it is ed to the masonry lacks the proper adhesive es, and it often separates and falls away. The usiness of Persia is very humble and simple. nost extensive is carried on from pulverizing uartz to putting the finished article on the t by the proprietor, his son, and four assistants. ifficult to give an estimate of the prices of tiles, variety of shape, ornament, and size seems to t equal the number of tiles produced, and each different price. Hitherto the foreign demand ıis product has been comparativeiy small. s have been executed for London and Paris. eavy cost of transport is the chief hindrance to port trade. So long as the camel, the mule, e ass are the only means of transport, Persian ies will labour under great disadvantages. ıtes for carriage are for tiles the same as for pecies of merchandise—viz., from 4d. to 6d. a r mile, which means from Teheran to Bushire, ve of customs and commission, about £16. onsul Tyler says in conclusion: "The Persian ıment gives no encouragement and lends no native industries, beyond being a purchaser of ods produced. A little help in reviving old ıd supporting modern ones would benefit a ection of the population, and give an impetus exercise of artistic and mechanical skill."

IRL FISHERIES OF THE DUTCH EAST INDIES.

ls constitute one of the most important articles ortation from Macassar. Up to the beginning decade they were sought almost exclusively by , fishing in the shallow waters in the bays, using any diving apparatus. In 1893, ng to the United States Consular Agent at Macassar, Celebes, an English company sent a schooner and some luggers to the Aroo Islands to try exploitation in deeper waters. This company appears to have had a good measure of success, for its fleet left the archipelago only when forced by a Dutch law of 1894, to the effect that only inhabitants of the Netherlands and Netherlands India, or companies established in these countries and under the Dutch flag, should be permitted to engage in pearl fishing. In 1896 the Eastern and Australian Trading Association of Amsterdam began operations, which, however, do not appear to have been successful, for the company liquidated in 1898. In the meantime, residents of Dutch India were beginning to pay more and more attention to the shell fisheries, and Europeans, Chinese, and Arabs endeavoured to make arrangements with the native chiefs, in whose territorial waters shells were supposed to be, and who generally granted the privilege of fishing for a fixed sum in cash, or a per-centage of the quantity fished. Such contracts, however, were legal only after the sanction of the Governor-General of Dutch India, which has been accorded without charge. Shell fishing is at present carried on on the east coast of the Aroo Islands, on the east coast of New Guinea, on the Halmaheisa, and the islands adjacent, on the east coast of Celebes, and the Timor group. An undertaking on a larger scale is the Djoempandang Maatschappy, established at Macassar in 1898, with a subsidised capital of £12,000, for fishing in the Timor waters, with a fleet of one schooner and ten luggers. The company has succeeded in securing apparently valuable concessions. The chief market for mother-of-pearl shells is Paris; only small quantities are shipped to London, Hamburg, and Amsterdam. There were exported in 1896 about 150 tons; in 1897, 200 tons; and in 1898, 250 tons. There is no doubt that 1899 will show a further considerable increase. Notwithstanding this augmentation, prices have been fully maintained. Aroo shells sell at Macassar at £140 per ton; Timor, Ceram, and New Guinea and Celebes shells at £80 to £100. Fishing is allowed during the whole year by the Government, but is occasionally prevented by the monsoons. Besides mother-of-pearl, there are also found in the archipelago cheaper varieties, which are obtained exclusively by the natives, and used in Germany and England for button manufacture, &c. Of bunda, or black-edged shells there is an export of about 80 to 100 tons yearly. Green snail shells are exported to the extent of at least 100 tons yearly, and exports of mussel shells amount to about 30 to 50 tons annually.

AUSTRALIAN OYSTERS.

Australian oysters are cheap and plentiful, being retailed in Sydney at from sixpence to one shilling per plate or bottle. The consumption is enormous,

lasting throughout the year, and amounting to several millions of bivalves annually. The whole of the New South Wales coast is admirably adapted for oyster culture. The climate, the nature of the coast-line, with its innumerable inlets and creeks, and the natural existence in several varieties of the bivalve itself, all combine to mark its suitability for the culture. Unlike the coasts of Great Britain, and even America, where the temperature during the summer months is frequently sufficient to prevent the shedding of spat, and generally to limit its quantity, the spat in New South Wales is distributed in unlimited profusion, and were due advantage taken of these favourable conditions, New South Wales oysters might become a leading article of oversea export. Their very abundance, and the ease with which they are gathered, forms a real cause of trouble. The equipment for a Sydney harbour picnic would be considered incomplete without the means of detaching oysters from the rocks, on which they are found in myriads. Until about thirty years ago, nothing was done to conserve this source of food supply. The oysters were collected by wholesale, without any steps being taken to secure a continuance of the supply. The natural results followed, and legislation became necessary to secure the preservation of the oyster fisheries; but much remains to be done.

At the present time, for the purpose of oyster culture, the Colonial Government grants leases of the foreshores of tidal waters, which may be defined as between the mean high and mean low water mark. The rental is 20s. per annum for every 100 linear yards. The maximum length for which a lease may be obtained is 2,000 yards; but as the same person may take out more than one lease, the portion of shore which may be acquired is practically unrestricted by the Colonial Oyster Fisheries Act. The lease may be taken for a term of ten years. Leases of deep water or natural oyster beds are also granted for an area not exceeding 25 acres, at a rental which must not be less than £2 per acre. Owing to bad management, the oyster beds of Port Jackson, Port Stephens, the Hawkesbury, and the Shoalhaven became greatly injured, so that the markets of Sydney have to depend upon the beds of the Manning, the Richmond, and other northern rivers, as well as places beyond the colony, for their supply of oysters. The appointment of a Fisheries Commission in 1880 probably prevented the entire extinction of the oyster industry in New South Wales, though the operations of the Commission have been much impeded from lack of sufficient legislation to enable them to check the improvidence of the lessees, who, with few exceptions, strip the oyster beds without regard to future supply.

There is but little doubt, says Mr. Coghlan, the New South Wales Government Statistician, that the establishment of "parcs," like those which may be seen along the coasts of France and Belgium, where oyster culture is conducted on scientific principles, would be remunerative, as the d[emand] for this delicacy is great, and continually inc[reasing]. There is, indeed, a wide field for remunerati[ve em]ployment in this direction, and experts in [the art] of oyster culture would find every possible [facility] placed at their disposal. During the year 14,701 bags of oysters were obtained from th[e] waters of the colony, being a satisfactory i[ncrease] on the takes of previous years; while in addi[tion to] this supply, 2,767 bags of oysters were im[ported] from other colonies, their value being set d[own at] £3,103. In 1898 the quantity imported was [...] bags, value £5,322; of which 6,236 bags cam[e from] New Zealand, 550 bags from Queensland, 28[...] from South Australia, 30 bags from Victori[a, and] 12 bags from Tasmania. A bag of oysters c[ontains] 3 bushels, and at the beginning of 1899 the pr[ice of a] bag of good oysters in Sydney ranged fro[m ...] to 40s.

STEAM TURBINES.

The Hon. C. A. Parsons lectured on "[...] Power, High Speed, Steam Turbines," at the [Friday] evening meeting of the Royal Institutio[n on] January 26.

After a brief historical reference to the [...] turbines described by Hero of Alexandria, and later by Bianca, Mr. Parsons said that with the [intro]duction of the dynamo the desirability of a [high-]speed engine was perceived, and the problem [was] to produce an ideal rotary engine. In 1884, [experi]ments were begun for the construction of a [...] turbine, which was designed to run as slow, wh[ile the] dynamo went as fast, as possible in order to ad[mit of] direct coupling. Special bearings were devi[sed for] keeping down the vibration, and the turbine [...] which was of 10-horse power, making 18,000 r[evolu]tions a minute, consisted of 15 successive t[urbine] wheels gradually increasing in size, to allow f[or the] expansion of the steam. Defects were notice[d, there] being a tendency to whip in the spindle with a[ccom]panying loss of efficiency, but it was seen that [these] would decrease with increase of size, and the[refore] efforts were made to construct bigger engines. [In] 1888, several turbo-alternators were supplied, c[...] horse power, non-condensing, running at nine thousand revolutions per minute, and taking [...] 35 lb. of steam per electrical horse-power, wh[ile in] 1892 the adaptation of turbines of the radial flo[w type] to work with condensers marked an epoch as r[egards] economy in steam power. Turbines of 2,000 [horse] power were now being constructed, still bigge[r ones] being contemplated, and a large turbo-alte[rnator] recently tested was found at full load to co[nsume] only 18·8 lb. of steam, 10 degrees super-heate[d, per] kilowatt hour. Leaving turbines for electrica[l pur]poses, Mr. Parsons said there seemed to be an imp[ortant] field for turbines to propel ships, for there ligh[t]

l balancing, and economy were required, and 392 turbines appeared capable of fulfilling these ions. Their high speed, however, was a drawsince it rendered direct coupling with an ordicrew impossible. Experiments were, therefore, , and economy suggesting a small boat, the *nia* was built, and fitted with engines of 2,000 horse-power. Many trials were made with s propellers, but the speed obtained was very disnting, owing to the excessive slip and inefficiency forms used. Mr. Parsons here digressed to n the "cavitation" phenomena which wasted wer, giving an ingenious experimental demonn of the vortices formed in the water by the reg screw, and pointing out that the best way to them was to have a coarse pitch on the screw, large blade area. Returning to the *Turbinia* cribed how she was radically altered, and fitted ew turbines. These consisted of three separate s—high pressure, intermediate, and low pressure driving one screw shaft, and each shaft carryee propellers. These alterations had a marvelfect. The speed was doubled, and 32¾ knots ticated on the measured mile, while when the was at the Naval Review it was estimated that as attained. There was but little vibration, e engines worked very economically. After ccess, larger works were constructed at Wallsn-Tyne, and contracts entered into with the alty for building a torepdo-boat destroyer with lacement of 350 tons to have a speed of ts. The engines were similar to those of the *nia*, but there were two distinct sets working crew-shafts, each of which carried two pro-. The two low-pressure turbines acted on the ner shafts, which also carried the reversing s that enabled the vessel to go backwards. ilers and auxiliary engines were as usual on ips, and the destroyer, which was named the could be manœuvred like an ordinary twinessel. On her second trial trip she attained a peed of 34·8 knots, her fastest trial being over s, or about 41 statute miles per hour, with an d horse-power of 11,000. The *Viper* was e fastest vessel afloat. After commenting on at ratio of her steam expansion, the steam her high-pressure engines through an 8 inch hile it left the low-pressure turbines through et 4 feet square, Mr. Parsons concluded his by sketching a few types of vessel in which his might be used. One was a cross-channel th a length of 270 feet, a beam of 33 feet, and ge of 1,000. She would carry 600 passengers, h engines of 18,000-horse power attain a sea f 30 knots, against the 19-22 now reached was a small unarmoured cruiser, with a f 420 feet, and a displacement of 2,800 tons. l with eight propellers and engines giving orse power she would be able, if necessary, tain a speed of 44 knots for eight hours.—*nes.*

Correspondence.

LOCAL GOVERNMENT AND ITS RELATION TO PARISH WATER SUPPLY AND SEWERAGE.

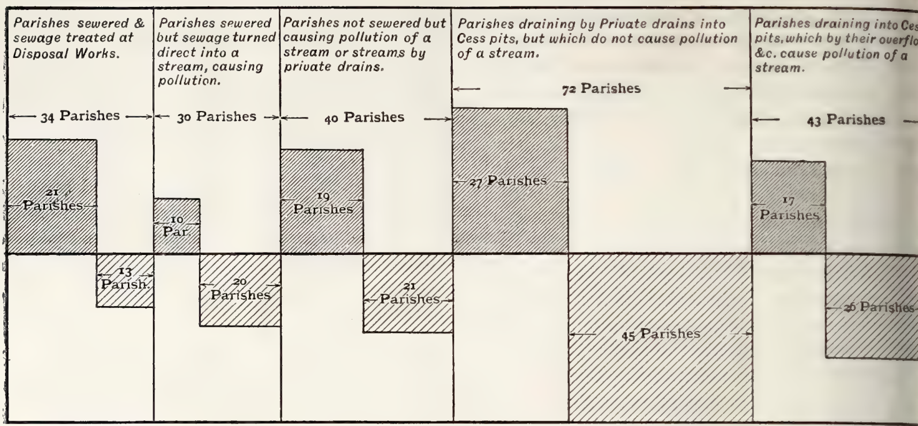
Mr. W. O. E. Meade-King has acted upon the suggestion made by Sir Alexander Binnie in the discussion on his paper (see *ante*, p. 208), and prepared the following diagrams, which show the numbers and per-centages of parishes subject to special sanitary conditions (p. 270).

Dr. SEATON writes to point out that when he spoke in the discussion on Mr. Meade-King's paper he referred not only, as reported in the *Journal*, to the dry earth system, but to the dry earth "and filtration gutter" system, as the one which he would have liked to have seen thoroughly carried out in some village. Dr. Seaton remarks that it is the great difficulty of dealing with slop water, without river pollution, which drives people to sewerage schemes, unless there be another practicable plan.

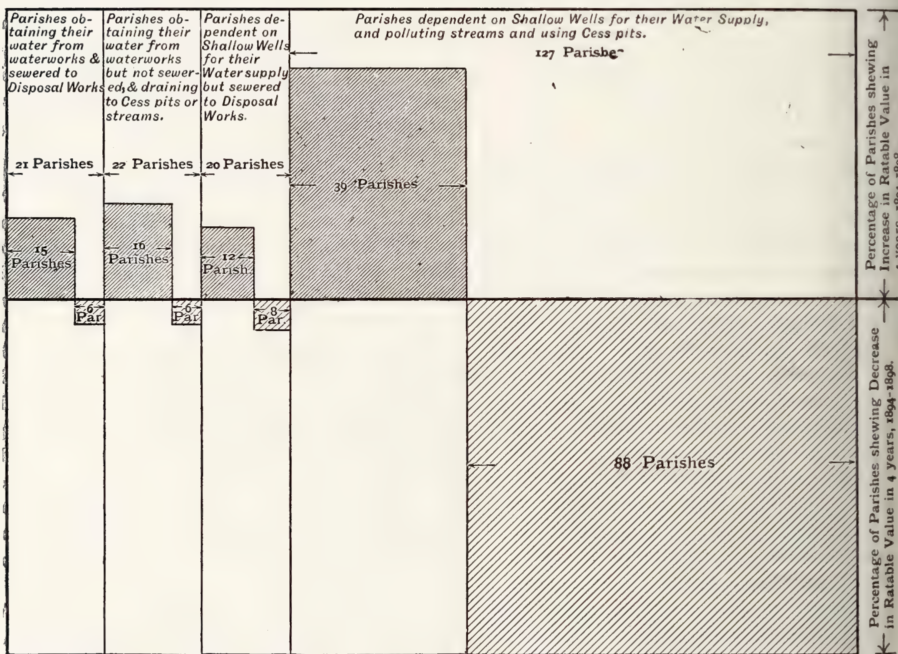
The paper by Mr. Meade-King on "Local Government and its relation to Parish Water Supply and Sewage," forms, in my opinion, a most valuable contribution to the Society's *Journal*, and deserves the widest possible circulation, as it deals with a subject fraught with the greatest importance to the country as a whole, and one which does not as a rule receive much notice at the hands of scientific bodies, the tendency being to spend much time in discussing the water or sewage problem as affecting a few large communities, and to almost entirely pass over the multitude of smaller towns and rural districts, which thus escape from the advantage which would accrue (if they were neglecting their duties) by the pressure of outside public opinion, and even by their boycott in extreme cases.

Mr. Meade-King infers from the figures at his disposal that the general tendency of good sanitation is to increase the rateable value of even a rural district, and although in the subsequent discussion some doubt was expressed on this point, it does not seem to me to be at all an unreasonable deduction.

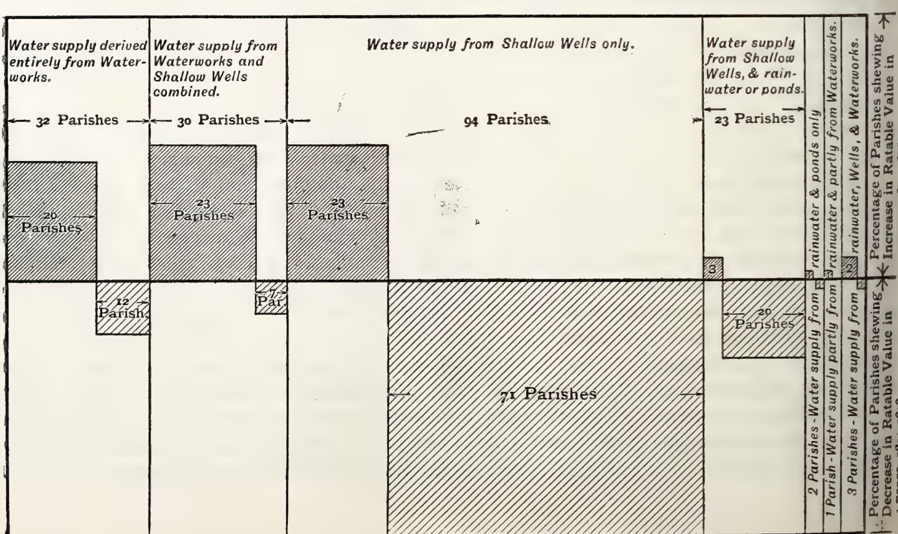
The present tendency of the rising generation in rural districts is towards concentration in big centres, but there is also a circulation of the more wealthy part of the population from large cities back to small towns and villages, and this circulation is bound to be checked by the slightest rumour of insanitary conditions prevailing. I consider, too, that the now universal cycling is having a material effect in reviving rural districts, and precisely the same check will obtain with the tourist public where good water and drainage systems are known to be lacking, or, what is generally the same thing, where zymotic disease is in evidence. I have again and again heard owners of property in private roads which were about to be made up by the local authority say that the



Parishes sewered & sewage treated at Disposal Works.
Parishes sewered but sewage turned direct into a stream, causing pollution.
Parishes not sewered but causing pollution of a stream or streams by private drains.
Parishes draining by Private drains into Cess pits, but which do not cause pollution of a stream.
Parishes draining into Cess pits, which by their overflow &c. cause pollution of a stream.
34 Parishes
30 Parishes
40 Parishes
72 Parishes
43 Parishes
21 Parishes
10 Par
19 Parishes
27 Parishes
17 Parishes
13 Parish.
20 Parishes
21 Parishes
45 Parishes
26 Parishes



Parishes obtaining their water from waterworks & sewered to Disposal Works
Parishes obtaining their water from waterworks but not sewered, & draining to Cess pits or streams.
Parishes dependent on Shallow Wells for their Water supply but sewered to Disposal Works.
Parishes dependent on Shallow Wells for their Water Supply, and polluting streams and using Cess pits.
127 Parishes
21 Parishes
22 Parishes
20 Parishes
39 Parishes
15 Parishes
16 Parishes
12 Parish.
6 Par
6 Par
8 Par.
88 Parishes
Percentage of Parishes shewing Increase in Ratable Value in 4 years, 1894-1898.
Percentage of Parishes shewing Decrease in Ratable Value in 4 years, 1894-1898.



Water supply derived entirely from Waterworks.
Water supply from Waterworks and Shallow Wells combined.
Water supply from Shallow Wells only.
Water supply from Shallow Wells, & rainwater or ponds.
32 Parishes
30 Parishes
94 Parishes
23 Parishes
20 Parishes
23 Parishes
23 Parishes
3
2
12 Parish.
7 Par
20 Parishes
71 Parishes
2 Parishes - Water supply from rainwater & ponds only
1 Parish - Water supply partly from rainwater & partly from Waterworks.
3 Parishes - Water supply from rainwater, Wells, & Waterworks.
Percentage of Parishes shewing Increase in Ratable Value in 4 years, 1894-1898.
Percentage of Parishes shewing Decrease in Ratable Value in 4 years, 1894-1898.

ragance would simply ruin them, and depopulate property. I have, with almost equal frequency, the same landlords subsequently admit that property has been improved out of all pro- on to the sum expended—the same principle good in improved sanitation for small towns rural districts—dirt and discontent go hand in and are valuable friends to the very evils of ntration in towns which we are nationally ring.

ose of us who are actively engaged in preparing nes for the smaller centres of population can y endorse Mr. Meade-King's remarks as to the eness, or general obliquity of vision, in rural ict Councils with reference to their duties in ry matters; in preparing and carrying out is schemes, I have come across some remarkable nces of imperfect appreciation by Councils of responsibilities, and I cannot help thinking that er like Mr. Meade-King's, coming with all the it of impartiality, and with unimpeachable tics, should be circulated, if possible, in a re- form amongst the smaller local authorities, as it l show them that the probabilities are on the of increase of rateable value being concurrent improved sanitary conditions, and would thus ve the main plank from the platform of the mprovement party. I am rather surprised to see a suggestion was made in the discussion to the earth closet system in places as big as bourne, which has, I suppose, a population ximating to 1,000. I have several times had to t on this system, and have come to the conclu- that it might be a fair arrangement in large, ed country houses, where no other means of sal is possible, and where plenty of male labour nstantly at hand to keep the pails changed. In ge size houses, and amongst cottage property, ystem breaks down utterly, pails are continually harged, or the dry earth runs short, or the collec- is often left to the respective landlords; the authority exercising no supervision, unless a nce becomes an absolute abomination to the bours; this was to my certain knowledge the not long since in Pangbourne. I had practical nce of it, as I was constantly staying there a few since. To make the earth closet system a ss in such places it is needful to have a sanitary ctor to every few streets. Assuming for a ent the success of the earth closet, there is still uestion of slop water to be dealt with. This contains organic and chemical impurities which quite as putrefactive as what is known as age" proper, and in volume it forms from 80 per cent. of the total daily flow. If allowed to scharged into ditches on permeable strata, and the inhabitants depend on wells for their water , there is nearly the same danger of the appear- of organic pollution in the drinking water that would be were ordinary crude sewage dis- ed. The only people who work the dry earth system to perfection are Chinamen—out of China. In Queensland and New South Wales the market gardening industry is largely in the hands of the Chinese, and they utilise effete organic matters to the extreme limit of their usefulness; but the conditions which obtain in the colonies are not the same as in rural England, and, rather regretfully, I have come to the conclusion that the earth closet system cannot be a success unless accompanied, as I have said before, by extraordinary supervision, which would entirely neutralise the advantage claimed by its advocates, viz., economy.

H. HOWARD HUMPHREYS, A.M.Inst.C.E.

THE UNDEVELOPED RESOURCES OF BOLIVIA.

In your *Journal* of the 2nd inst. you publish Sir Martin Conway's paper on "The Undeveloped Resources of Bolivia." In the discussion, in which I took part, you make me say, referring to the Mamoré river, "The district which the river flooded was swampy." This refers to the Purús river, which the reporter of my remarks has omitted to mention, and not to the Mamoré. I said that the whole northern river system of Bolivia, including the Beni, the Mamoré, and other streams, lies upon a great shelf between 600 and 700 feet above sea level, and 400 feet above the basin of the Brazilian river, Purús, which yearly floods a vast area of country which is very swampy.

Northern Bolivia concentrates its drainage upon falls of the Madera affluent of the Amazon, and is singularly free from swampy lands. I doubt if there is an equal area in the world which exceeds it in fertility and capacity to produce constant and enormous crops.

GEORGE EARL CHURCH.

216, Cromwell-road, S.W.
4th February, 1900.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

FEBRUARY 14. — "The Diffraction Process of Colour Photography." By PROFESSOR R. W. WOOD. SIR WILLIAM DE W. ABNEY, K.C.B., F.R.S., will preside.

FEBRUARY 21. — "Artistic Copyright." By EDWIN BALE. SIR L. ALMA TADEMA, R.A., will preside.

FEB. 28.—"Pneumatic Despatch." By PROFESSOR CHARLES A. CARUS-WILSON, M.A. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., will preside.

MARCH 7.—"Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources." By DR. CARL PETERS.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S. The RIGHT HON. SIR WILLIAM HART DYKE, M.P., will preside.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

FOREIGN AND COLONIAL SECTION.

At 4.30 o'clock:—

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

APRIL 2 (Monday).—"The Century in our Colonies." By the RIGHT HON. SIR CHARLES WENTWORTH DILKE, BART., M.P.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

BENNETT H. BROUGH, "The Nature and Yield of Metalliferous Deposits." Four Lectures.

LECTURE IV.—FEBRUARY 12

Sources of the world's supply of copper ore—Principal mines now worked—Deposits of the ores of lead and other metals.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. Bennett H. Brough, "The Nature and Yield of Metalliferous Deposits." (Lecture IV.)

Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 7½ p.m. (Graduates' Meeting.)

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Dr. L. C. Parkes, "Public Health Statutes and Bye-laws."

Imperial Institute, South Kensington, S.W., 8½ p.m. Miss H. M. Kingsley, "West Africa, from an Ethnological point of View."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. H. T. Scoble, "The Bacteriological Treatment of Sewage."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Prof. Norman Collie, "Mountaineering in Switzerland and Scotland."

Medical, 9, Conduit-street, W., 8 p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Vivian Lewes, "Modern Explosives."

TUESDAY, FEB. 13...Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. Ray Lankester, "The Structure and Classification of Fishes." (Lecture V.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. W. B. Farr, "Moving Loads on Railway Underbridges." 2. Mr. C. F. Findlay, "Note on the Floor System of Girder Bridges."

Childhood Society, 74A, Margaret-street, W., 8 p.m. Dr. Garnett, "Early Stages of Technical Education."

Photographic, 66, Russell-square, W.C., 8 p.m. Annual Meeting.

Anthropological, 3, Hanover-square, W., 8½ p.

Colonial, Whitehall-rooms, Whitehall-place, 8 p.m. Mr. Everard F. Im Thurn, "B Guiana and its Boundary."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8

Asiatic, 22, Albemarle-street, W. 3 p.m.

WEDNESDAY, FEB. 14...SOCIETY OF ARTS, John-s Adelphi, W.C., 8 p.m. Prof. R. W. V "The Diffraction Process of Colour Photogra

Sanitary Institute, 74A, Margaret-street, W., 8 1. Mr. W. Nisbet Blair, "The Insanitary Con of London Streets." 2. Dr. Sykes, "Object Methods of Inspection, Nuisances, &c."

Japan Society, 20, Hanover-square, W., 8½ Mr. W. H. Behrens, "Concerning Evoluti Certain Forms of Japanese Applied Art."

Royal Literary Fund, 7, Adelphi-ter., W.C., 3

Mining and Metallurgy, Geological Mu Jermyn-street, S.W., 8 p.m. Mr. J. B. Ty "The Gold Bearing Alluvial Deposits o Klondyke District."

THURSDAY, FEB. 15...Royal, Burlington-house, W., 4½

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. M C. Shenston, "Photography of British Pl 2. Dr. R. F. Scharff, "A New Land Plan from the Pyrenees."

Chemical, Burlington-house, W., 8 p.m. 1. M Edward Divers and Masataka Ogawa, "Amm Amidosulphite," 2. Messrs. Edward Diver Masataka Ogawa, "Products of Heating Am ium Sulphites, Thiosulphates, and Trithionate Dr. S. Young and Emily C. Fortey, "Note o Refraction and Magnetic Rotation of I methylene." 4. Messrs. Edward J. Russel Norman Smith, "The Combination of Su Dioxide and Oxygen." 5. Mr. E. J. R "Note on the Estimation of Gases Cont Sulphur." 6. Mr. A. G. Perkin, i. "Api Apigenin." (II. "Note on Vitexin."); ii. Yellow Colouring Principles of Various T Matters." (VII.)

London Institution, Finsbury-circus, E.C., 6 Mr. John Hart, "Some Legal Aspects of and Currency."

Royal Institution, Albemarle-street, W., 3 Prof. H. H. Turner, "Modern Astron (Lecture II.)

Historical, St. Martin's Town-hall, Charing- road, 5 p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 7 p.m

Camera Club, Charing-cross-road, W.C., 8¼ Mr. W. B. Worsfield, "Some Aspects of A Egyptian Art."

FRIDAY, FEB. 16...Royal Institution, Albemarle-street 8 p.m. Weekly Meeting. 9 p.m. Mr. H. W ton Smyth, "Life in Indo-China."

Civil Engineers, 25, Great George-street, S. p.m. (Students' Meeting.)

Sanitary Inst., 74A, Margaret-street, W., 8 Prof. Bostock Hill, "Trade Nuisances."

Quekett Microscopical Club, 20, Hanover-s W., 8 p.m. Annual Meeting.

Geological, Burlington-house, W., 3 p.m.

SATURDAY, FEB. 17...North-East Coast Institute of neers and Shipbuilders, Newcastle-on-Tyn p.m. Graduates' Meeting.

Waterworks' Engineers, Geological Society's R Burlington-house, 10 a.m. Mr. C. E. Jones, Control of Sources of Water Supply."

Royal Institution, Albemarle-street, W., 3 p.m W. L. Courtney, "The Idea of Tragedy in A and Modern Drama." (Lecture II.)

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FRIDAY, FEBRUARY 16, 1900.

communications for the Society should be addressed to he Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

Ir. Bennett H. Brough delivered the th and last lecture of his course on "The ure and Yield of Metalliferous Deposits," Monday evening, 12th inst.

n the motion of the Chairman (Mr. H. ERMAN), a vote of thanks to the lecturer his valuable course was passed.

he lectures will be printed in the *Journal* ng the summer recess.

Proceedings of the Society.

INDIAN SECTION.

hursday, Feb. 8, 1900, Lord Edmond ZMAURICE, M.P., in the chair.

r George Birdwood, K.C.I.E., C.S.I., said:— he absence of Sir Steuart Bayley, the Chairman of Indian Section of the Society of Arts, I feel sure I shall be acting acceptably to every one present efore Lord Edmond Fitzmaurice calls upon Mr. lean to read his paper, I briefly refer to the w with which we all heard this morning of the 1 yesterday, at his house, Oaken-Holt, near rd, of Sir William Wilson Hunter. I need say ng here, and in this assembly of Anglo-Indians, ir William Hunter's public career, or of the al services which, as a brilliant writer, he rendered nd all his countrymen, in making the people dia better known to the people of England. I desire to have entered in the minutes of this ng, how highly we Anglo-Indians have s esteemed and honoured Sir William n Hunter for these services, and how sin- we deplore his death. Regret is expressed me of the morning's papers that Sir William n Hunter should have been called away from nidst before the great history of British India, ich the last years of his life were absorbed, een completed. We all know the feeling, to which touching expression is given in one of the letters of the younger Pliny. I do not myself altogether appreciate it, nevertheless I am happy in being able to state that Sir William Hunter's last projected work was, in a restricted sense, completed before his death. The great void to be bridged over in the history of British India was from the signature of the Charter of Elizabeth to the Union of the two East India Companies. Of this void, extending over the whole of the 17th century, the period to the epoch-making Massacre of Amboyna (17 Feb., 1623-4) was bridged by Sir William Hunter's first volume recently published; and his second volume, a large portion of which has already been corrected for the Press, will carry forward the history of the period to the close of the 17th century, and virtually to the Union of the Old and New Companies during the first decade of the 18th century. After that date the history of British India is, in the original and authentic papers of the United East India Company, the "Honourable East India Company" of their youth, an unbroken record. This is a matter of congratulation for all, and cannot but prove a solace to those who as nearest and dearest to him most deeply lament what may well be felt to be his premature fate. But Sir William Hunter's reputation does not rest on his "History of British India." His fame as a writer was definitely fulfilled thirty years ago, on the publication of his very first volume, and his all-sufficing epitaph might well be:—"He wrote 'The Annals of Rural Bengal.'" It is in the noblest sense "*un livre de bonne foi*," a book that never dies; and death has no power over one where work is deathless. It is in this spirit of pride in Sir William Hunter, as an enduring honour to his service and his country, that I refer to his loss, and it is in this spirit I desire to convey to Lady Hunter the expression of our profound sympathy with her in her overwhelming bereavement. While, therefore, we bring handfuls of lilies and strew their white blossoms on his grave, and utter the last three-fold farewells, above all rises the exultant apotheosium from our hearts:—

> He has quaff'd the Soma bright
> And All the Gods has known;
> He has entered into Light
> And has Immortal grown.

Mr. Maclean, M.P., said that he had read with the deepest regret that morning the intimation in the *Times* of the death of Sir William Hunter. Sir William was a man who, without any adventitious aids of fortune or interest, raised himself by his own merits to a very conspicuous position as a man of letters and a politician. It seemed to him only yesterday, though he was afraid it was about thirty years ago, that a publisher in Edinburgh showed him the proof sheets of the volume of Sir William's "Annals of Rural Bengal," and asked if he did not think there was a promise of future greatness in it. The publication

of that book was a revelation. It showed that a new literary star had arisen on the Indian horizon. It was a book that threw a flood of light on the economic condition and domestic habits of the Indian people, and opened up a school of literature which up to that time had been too much despised by Anglo Indians. Sir William was also a man who was distinguished in the political world. The weighty contributions which he sent to the *Times*, and which were always read with great interest, kept him abreast of current politics, and helped him to mould public opinion on all the great questions affecting our Indian Empire. He had passed away, as Sir George Birdwood had said, at a comparatively early age, but full of honours, and his memory would always be held in deserved respect, whilst his name would be remembered with gratitude and pride in the country which he loved so well, and to which he devoted the full powers of his mind.

The CHAIRMAN said everyone must feel what a great loss the Indian Empire and literature had suffered from the sudden death of Sir William Hunter. They might all have hoped that he would have had many years more of literary activity accorded to him, and only a short time before his death he had been in communication with him with regard to some assistance he thought he could give him in a search he was making to recover the original, or a copy, of the first charter of the East India Company which, as many were aware, was lost at the time of the Restoration in some curious way, when many other things in Government offices were lost; but he was sorry to say he feared that any assistance he could give did not result in Sir William obtaining what he wanted. He was sure everyone would cordially sympathise with what had fallen from Sir George Birdwood and from Mr. Maclean.

The SECRETARY of the Section read a telegram which he had received from Sir Andrew Clarke, G.C.M.G., at one time Minister of Public Works in India, expressing his regret and disappointment at not being able to be present that afternoon, and assuring Mr. Maclean of his general support to his project, which he had long since advocated.

The paper read was on—

NEW PROJECTS OF RAILWAY COMMUNICATION WITH INDIA.

By J. M. MACLEAN, M.P.

The possession of the trade of India has been, from time immemorial, one of the chief causes of rivalry among the States of the Western world, and one of the most powerful influences in promoting the growth of nations in prosperity and wealth. While yet the arts and industry of Europe were only in a ru mentary stage, and barely yielded enou return to provide for the actual needs of m India was already the home of a highly-refir and luxurious civilisation. Her fertile soil a ingenious and patient people produced a sup abundance, not only of all those fruits of earth which flourish in a tropical climate, of all the most exquisite fabrics which hum skill and taste can devise, so that Inc besides maintaining her own population, co spare for export to foreign countries a lai margin of articles of merchandise which w coveted as ministering to the comfort a enjoyment of civilised life. This comme was either carried across the Indian Oce and up the Red Sea in ships manned by bold and daring Arab sailors, whose scendants on the Western coast of In are the *lascars* of our own day, they were transported in caravans co sisting of thousands of camels, whi traversed, by well-guarded roads from well-appointed halting-place to another, whole Asiatic continent, and, passing throu a long chain of thickly-populated and flouri ing monarchies, exchanged their goods in cities and colonies with which the coasts the Levant and the Black Sea were studd The variety, extent, and opulence of this co merce can hardly be appreciated unless remember that the great continent of Asia h been, for thousands of years before Christian era, and continued to be for at le a thousand years after that date, a region habited by a dense population, who practi the arts of peace more than those of w Even down to the end of the 13th century A. we know, from Marco Polo's book, that su famous cities as Damascus and Baghdad w as flourishing as they had been in "the gol prime of good Haroun Alraschid." Tr was protected by the strong hand of descendants of Chingiz Khan. According Sir Henry Yule, "Alexandria was still larg frequented in the intervals of war the great emporium of Indian wares, the facilities afforded by the Mongol c querors, who now held the whole trade f the Persian Gulf to the shores of the Casp and of the Black Sea, or nearly so, w beginning to give a great advantage to caravan routes which debouched at the port Cilician Armenia in the Mediterranean an Trebizond on the Euxine." The profits gai by India through this commerce were e mous. We know how constant was the

f classical writers over the immense sums ı gold and silver paid for Indian wares hich made India the sink of the precious ıetals. Gold was not only hoarded, but isplayed in India with a profusion unknown sewhere, except during the visit of the ueen of Sheba to King Solomon. "The ravidian kingdoms of Southern India," says ule, "were as yet untouched by foreign ›nquest, and the accumulated gold of ages ıy in their temples and treasuries an easy prey ›r the coming invader." Milton's well-known nes—

> "Or where the gorgeous East, with richest hand,
> Showers on her kings barbaric pearl and gold"—

ıows how powerfully the revelation, at the eginning of the 17th century, of the astound- ıg wealth of India affected the imagination of ıe hardy mariners from the West.

The beneficent commerce of the overland, caravan, routes through Asia was over- ırown by the Tartar conquests of the 15th entury, which depopulated vast regions of ıe continent, extinguished industry and der, and transformed the seats of mighty npires into haunts of desolation and ıarchy.

But, in the same century, Providence, orking in its own mysterious way, opened new route to India, that by the Cape of ood Hope, by which the commerce of the ast with Europe could be securely and ofitably carried on without the risk of dis- rbance from the wars that shook the con- nent of Asia.

From that time onwards the riches of ıdia have been the prize of the strongest nong the maritime Powers of Europe. ngland successively defeated all her rivals - Portuguese, Dutch, and French — and ıthered into her own hands the whole ıde of the East, including not only India ıt China, where our commerce gained a ›thold largely through military enterprises dertaken from India. This monopoly was nsolidated during the long struggle with ance at the beginning of the 19th century, ıen English fleets swept the seas clear of ery foreign ship, and it is certain that immense wealth derived by our mer- ants from the Indian trade enabled England bear with ease the colossal burdens im- sed upon this country during the Napoleonic rs. The whole ocean from the eastern ıst of Africa to the north of China be- ne a closed sea for the English, and this te of things lasted till the cutting of the Suez Canal permitted other European nations to burst into that sea, to compete with us at every point in the East, and seriously to re- duce the enormous profits the Eastern trade formerly brought to these shores.

Now, it would appear that a new economical and commercial revolution is impending, and that maritime commerce is threatened with serious competition from the new trans-conti- nental railways which Russia, in particular, is constructing with so much energy and fore- sight in Asia. The line across Siberia has already been carried, with only a break at Lake Beikal, as far as the commencement of the navigable water-way to Vladivostock, and, before five years more have elapsed, it is pro- bable that direct communication will have been established between Moscow and Pekin, and the Chinese capital brought within a week's journey of Europe. This immense change will breathe fresh life into the dry bones of Asia, and cannot but revive the great overland trade which had fallen for so many centuries into desuetude. Russian and German commercial travellers will swarm into the industrial districts of the Chinese Empire, delighted at being set free from the long and toilsome sea journey, and bringing goods with them for exchange against silk and tea, and gradually it will be found that Chinese commodities brought by this route will supply the wants of all Asia, and of Europe, as far at least as the lati- tude of Berlin and Vienna. But what inte- rests us to-day is the knowledge that the projects of the Russian Emperor do not stop short with the completion of the Siberian railway. A branch from the main line has been projected and surveyed which will extend from Orenburg to Samarcand. This will complete, by a junction with the Trans- caspian railway, the iron girdle with which all Central Asia will be embraced by Russia, and a vast region of fertile soil restored to civilisation. Moreover, it will bring the famous birthplace of Tamerlane within six days' unbroken land communication with Calais, and offer a tempting opportunity for the further progress of the railway through Afghanistan to Peshawur, and for that linking- up of the Russian and Indian railway systems which would reduce to nine days the journey from London to Calcutta, and would thus confer incalculable benefits upon the whole of the East. I well remember that this scheme was foreshadowed by M. de Lesseps, the creator of the Suez Canal. He made a journey to Bombay for the purpose of bringing it before

the Indian Government, and proposed to return home through Afghanistan and Central Asia to Orenburg, so that he might examine for himself the practicability of the route. Unfortunately, the Afghan War broke out at that time, and M. de Lesseps abandoned his enterprise. But what was then a dream is now a practical possibility. It needs nothing more than the construction of a very few hundred miles through the passes of the Hindoo Khoosh and the Himalayas ; and this would be an easy task for modern engineers. I have conversed on this subject with some of the foremost public men of England and Russia, and I have found that the most enlightened statesmanship of both countries is in favour of such an understanding between the two countries as would lead to the realisation of a scheme which we all ardently desire.

This route appears to me to possess unquestionable advantages over any other that can be named. Now that the Transcaspian Railway through Russian territory has been opened as far as Samarcand, and a branch made as far as Kushk, in close proximity to Herat, many people favour the completion of this line of communication as far as Chaman, below Candahar, which is the terminus of the Indian railway system. The line from Herat to Candahar, a distance not exceeding 500 miles, runs through a comparatively easy country, and could be built cheaply and expeditiously. But this line would debouch into India at its extreme western limit, and would be complicated by the break of the Caspian Sea, across which goods and passengers must be conveyed by steamer. What is wanted is unbroken land communication from Calais to Calcutta, and this is supplied by a line through Orenburg, which avoids both the Caspian and the Sea of Aral, and runs for the greater part of the way through a region well known in ancient times for its fruitfulness.

A similar objection to that taken against the Transcaspian line might be urged against the new railway through Mesopotamia, for which a German syndicate has just obtained a concession at Constantinople. This line runs from the northern shore of the Bosporus to Baghdad and Basra, and no doubt the promoters contemplate ultimately extending it along the eastern coast of the Persian Gulf as far as Kurrachee. It seems an astonishing thing, when we reflect that a survey for a Euphrates railway was made sixty years ago, and that for the greater part of this century English influence has been supreme througl
out Turkey in Asia, to find that Germany h
now stepped in and appropriated the whole
this fertile territory to herself, withou
apparently, encountering any protest on th
part of our Foreign Office. The Germans a
our most formidable commercial competitor
and we can hardly view with equanimity tl
transfer to the enterprising German Empire
the right to develop the country along tl
Euphrates and Tigris valleys, and to ga
access to the open waters of the Persian Gu
A line as far as Baghdad might not seem
objectionable, but this concession includes tl
seaport of Basra as well, and it has always, ar
rightly, been the instinctive tradition of o
Foreign Office to view with the utmost jealou
the appropriation by any rival Power of
port at the mouth of any of the gre
navigable rivers of the world. It was t
control of the Nile Valley that made t
conquest of the Soudan so valuable to us, ar
there is not one of the great rivers of Afri
and Asia which we have not annexed or throv
open to our commerce. To a maritime natic
indeed, this access to the alluvial valley
watered by navigable streams, is as the brea
of its nostrils. The Germans tell us th
freedom comes from the mountains, but
would add that civilisation dwells in t
valleys. Population, industry, and wea
flourish on the banks of the rivers which car
down to the sea the commerce that is ther
transported in our ocean steamers to all pa
of the world. I am hardly surprised, the
fore, at the opinion ascribed to Lord Curz
the present Viceroy of India, that any Engli
Minister ought to be impeached who allowe
foreign Power to obtain a foothold on t
Shat-el-Arab, the stream formed by the c
fluence of the Tigris and the Euphrates. H
political necessity can alone have moved L
Salisbury to take this course. He has pr
ably been influenced by two considerations—
the first place, he has established Germ
authority in Syria and Mesopotamia, athw
the direct lines of advance of Russia to
Mediterranean and the Persian Gulf; and,
the second place, he has secured for himsel
free hand to do what he likes in Egypt a
South Africa.

But, so far as communication with India
concerned, it does not appear to me that t
route can ever interfere seriously with our ov
sea commerce between England and Bomb
So long as the Bosporus is unbridged, tra
through Turkey in Asia would always be e

-assed by a break of bulk, and all merchants aware that this obstacle in itself would tralise most other advantages. Since the ning of the Suez Canal projects of a hrates Valley railway have fallen into dis-our in this country, because the immensely eased facilities for quick maritime com-nication have made it unlikely that any bined sea and land line to India will act either goods or passengers. I come k, therefore, to my conclusion that the sent over-sea route has no competition to r except that from a through land line from ais to Calcutta, which would enter India r its centre, and be continued down the at valley of the Ganges.

he most disquieting feature of all these way projects is the evidence they afford the immense commercial activity that is v spurring on both Germany and Russia new enterprises. We know what a for-lable rival Germany has become to this ntry in all parts of the world, but less d has hitherto been paid in England to prodigious industrial and trading develop-nt that has taken place in Russia. Even Trans-Siberian railway has been promoted l pushed forward for commercial rather n military ends, though I do not for a ment say that the latter have been lost ht of. When I was at Aden, a little more n a year ago, there were a number of sels in the harbour flying the Russian flag, l I remarked to a Russian diplomatist, o was travelling eastward in the P. and O. amer, that Russia appeared to be sending good many troops to Port Arthur. He in-ed me to accompany him and see the ships myself. I did so, and found these vessels re crowded with emigrants from Southern ssia, fathers of families with their wives l children and household goods, who re on their way to take up their resi-ice in the country opened by the new erian line of railway. This migration of ssian peasants was a complete revelation. recalled to my recollection a sight I once on the Suez Canal works before that great er-way was opened. I stood on the edge the great dry basin of the Bitter Lakes, saw the blue waters of the Mediterranean ring in to convert it into an inland sea ch is now traversed by hundreds of ships. s reclamation of the desert to civilised s appealed forcibly to the imagination, a similar work is now in progress in thern Asia, where a hard-working agri-cultural population is settling down in what were the waste regions of Siberia. These emigrants are largely helped by the Govern-ment, which supplies them with houses, plots of land, and agricultural implements free, and relieves them of all taxation for several years. They will form a connecting link between Russia and Northern China, where already a docile and industrial population provide a trade which is rapidly increasing in volume.

The Siberian project was probably inspired by the great success which has attended the completion of the Transcaspian railway through Russia's new possessions in Central Asia. We can most of us remember the airs of superiority that English politicians used to give them-selves in talking of Russian adventures in the almost unknown country beyond the Caspian. To take a conspicuous instance, the Duke of Argyll ridiculed as "Mervousness" the appre-hensions entertained by far-sighted statesmen as to the probable effects of the Russian conquest of Merv. But Russia established and consolidated her possessions up to and beyond the Oxus, and bound them together by the railway to Samarcand, and now we find that, instead of "gorgons and hydras and chimeras dire," this country of the Turko-mans is fruitful and prosperous, and that a chain of cotton plantations exists where once there was nothing but desert. Not only have the Russians turned the whole of this territory to account, but they have pushed their trade successfully into Khorassan and the whole of Northern Persia. They have built good roads from the Caspian to both Meshed and Teheran, and all the reports of our consular officers show that Russian trade is increasing, while English trade is falling off in this part of the world. The new Russo-Persian loan shows how Russia is consolidating her financial position in Persia. The Russians have also secured from the Shah of Persia the renewal for another term of five years of the exclusive right to construct railways in Persia, and their administration is everywhere marked by pro-gress, while British trade is content with the slow and uncertain transit of our goods over a thousand miles of roadless and badly-policed territory from Bushire and Bunder Abbas. Yet I have been assured on excellent authority that a good many years ago the Shah of Persia made an application to our Foreign Office for the investment of British capital in the construction of Persian railways; but this proposal was treated with contempt. The greater intelligence shown by Russia is already

having the effect of transferring a considerable portion of our trade to Russia. Formerly, tea from China was brought to Bombay, and shipped thence to the Persian Gulf ports for conveyance by land into Central Asia. Now, however, the middleman has discovered for himself that by forwarding this tea from Colombo up the Red Sea, and round to the port of Batoum in the Black Sea, he can obtain a more secure and expeditious, and a cheaper, transit for his goods by the Trans-caucasian railway as far as the Caspian, and thence into Central Asia; and this trade has been lost to Bombay.

We have perhaps been accustomed in this country to fix our eyes too exclusively on the advantages of maritime communication, and to underrate the giant strides which Continental nations are making by means of their railways. Let me give you an illustration of what I mean. When I first visited Venice, thirty years ago, I found that by far the best mode of conveyance for goods purchased there was by steamer to London, and all trade with Italy was practically carried on by English ships. Now, our consular reports from Italy repeat year after year the old story of the success in trade achieved by the foreigners, and strong complaints are made of the want of enterprise of the British merchant. But is there not another and more natural cause for the decay of British trade? Turn your eyes to the map of Europe, and you will see that, largely through the energy and ingenuity of Swiss railway engineers, the Alps, which once shut off Italy by land from the rest of Europe, have now ceased to exist. This chain of mountains has not been levelled; but, what comes to the same thing, it has been tunnelled in half a dozen different places from the Mont Cenis to the Brenner Pass, and the success of these tunnels has now led to the construction of another route through the Simplon. Now, any one who visits the Riviera can see for himself that the Alpine railways, and especially the St. Gothard route, bring swarms of German excursionists into Southern France and Northern Italy; and the German traveller is becoming a more important person in this part of the Continent than even the English or the American traveller. A similar change has taken place in the course of trade. Italy now sends vast quantities of her agricultural produce over the Alps into the thickly-populated valley of the Rhine and the countries of Central Europe, and she takes in return the manufactures of France and Germany, to the p judice of British trade, which can no long compete with the cheap land traffic.

A similar revival of land traffic seems lik to change the face of all Asia. What we witnessing, in fact, is the renascence of As and it troubles one to reflect that Engla which was once supreme in Asia, is taking part in this great movement. Are we, in pursuit of a shadowy suzerainty in So Africa, letting slip the substantial advanta which lie ready to our hand in an infinit richer continent? At all events, we let ot Powers take the initiative, while we rem indifferent and apathetic. It was not alw so. More than sixty years ago the Court Directors of the East India Company s Alexander Burnes to Cabul and Bokhara report upon the new markets that might opened for Indian trade in Central Asia; now every Asiatic market outside our c Indian border has been seized by our riv and the Indian Government is so much p occupied with high politics and high jinks Simla that it leaves trade severely alone.

Our inaction is, of course, largely due to unfortunate relations which we maintain India with the Ameer of Afghanistan. Ang Indian statesmen cherish, for the most part rooted conviction that we must leave the Am to go his own way without interference fr us; and to such an extent is this doctrine total abstinence carried that we have actu kept lying at Chaman, the terminus of Indian railway system, beyond the tun which we have constructed through the Kho Amran range, all the railway materials for building of an extension to Candahar, wh we, nevertheless, do not venture to ma The latest news we have from Afghanista that the Ameer has actually broken up roads from Herat to Khushk on the Russ border, to stop the growing trade in that dir tion. Now, Afghanistan is simply an isola remnant of barbarism, enclosed between two great living empires of England Russia, and employing the mutual jealous these two Powers to maintain its independer The rule of the Ameer is not much less c or oppressive than that of the Khalifa, wh we have just destroyed in the Soudan. we support him with a very large subsidy, in return he places heavy duties on our c merce, and stirs up the frontier tribes to m war upon us. How much longer is this p chief to be allowed to block the high road civilisation, and to prevent the opening of

l friendly intercourse between England and ssia? A joint representation from these) Powers at the Court of Cabul would force Ameer to consent at once to the construc- n of railways throughout his dominions. lcutta and Kurrachee would then become seaports for Russian goods desiring an let on the Indian Ocean, and India would be e to conduct once more a large and lucrative de in her own articles of merchandise with Persian and Central Asian markets. I ve heard it said that through railways to lia ought not to be built, because we may ne day go to war with Russia. On the ne principle, express trains ought to cease nning from Paris to Berlin, because some war may again break out between France l Germany. The objection has been made t the linking up of the Indian and Russian lway lines would involve a much larger itary expenditure on our Indian defences. t even now, while the Russians are hundreds niles away, we watch their every movement h suspicion and alarm, and maintain a at army in constant readiness to resist their vance towards India. Our preparations for r need not be more formidable if the two pires were no longer separated by a belt of itral territory, and if both Powers well lerstood that the first step beyond a fixed would be equivalent to a declaration war.

am afraid that the only real obstacle to the npletion of a through overland line is the villingness of our Foreign Office to move of its accustomed groove, and to exercise ittle ordinary foresight in dealing with a fectly changed condition of affairs. As I e said elsewhere, Lord Salisbury was no bt in the right twenty years ago when he ised his fellow-countrymen to study large os; but now the world has grown much ıller, and the great capitals of Asia (Pekin, narcand, and Calcutta) have been, or can brought within a week's easy journey from scow. It is imperative, therefore, that we ıld adapt ourselves to the changed circum- ces of the time. Mr. Arthur Balfour, a ago, when speaking of the settled policy ur Foreign Office, made use of the unfor- te expression, "Sufficient unto the day is evil thereof." This maxim was, I believe, avourite motto of a king known in history thelred the Unready, and, if the Foreign e accepts it as a guide, it accounts for n that has happened since Mr. Balfour e his avowal. But I think you will agree with me that the Department which administers the foreign affairs of a mighty Empire should be animated by a policy of greater courage, determination, and enterprise.

DISCUSSION.

The CHAIRMAN said before inviting discussion he should wish to convey to Mr. Maclean the cordial thanks of the meeting for the very able and interesting paper he had read. It must have been present to all minds that this question was one which had many sides. It only needed a glance at the map to see that the territories, the future of which was involved, were enormous. They represented lands which in former ages played a very great part, and which might play a great part again, and also territories which were of great wealth and importance even at present. As an instance of the first, he might take the vast territories in the interior of Asia, which used to be called in their school days Central Asia, because there was no other particular name by which to describe them, but which we were now beginning to know better, because they were gradually coming back into the region of civilisation out of which they were driven centuries ago by the great invasions of Genghis Khan and Tamerlane. In the second category we might include Turkey, both in Europe and Asia. That was the part of the subject which came most home to him, because many years ago he had the honour after the Russo-Turkish war to represent this country as Commissioner in Turkey, and he recollected how when he visited a point which he was very fond of, because of the magnificent view on the northern shore of the Bosporus, from which you could see right away almost into the interior of Asia Minor, he used to think of the immense future a scheme of railway development was bound some day or other to play in that region, in bringing again into connection our Indian Empire with the various countries, of which England was one, at the western end of Europe. That point Mr. Maclean had touched upon in a very interesting manner. Having no engineering knowledge he would not attempt to say how far it was supposed to be possible within a time worth calculating to bridge the Bosporus, but he could not help imagining that a generation which had bridged the St. Lawrence and the Forth, and even talked of making a Channel tunnel, would not find it impossible to bridge the Bosporus at the narrowest point, which was almost the one which he had described. As had been said, until that was done, there would be a great obstacle to the making of any line across Asia Minor, the principal means of communication between this end of Europe and India. In connection with that question of breaking bulk, the making of a Channel tunnel was also a matter to be borne in mind. As Mr. Maclean had pointed out, there were already certain classes of goods the commerce in which, owing to the making

of the enormous tunnels under the Alps, had to a great extent passed out of English hands. When he was Under-Secretary of the Foreign Office he had charge of the Commercial Department, and he remembered it being put before him on more than one occasion by the talented gentlemen whose services were at his command, that our trade in certain classes of pottery and china, of which we had formerly almost a monopoly in Italy, had been driven out by German goods simply because they could go through the Great St. Gothard Tunnel without break of bulk, while all English goods had to get across the Channel. These considerations naturally applied in a still greater degree to commercial communication with the far East. Goods which had to break twice—in crossing the Channel and in crossing the Bosporus—would be at an enormous disadvantage as compared with those which escaped that difficulty. Some years ago he scandalised some of his audience in the House of Commons when he expressed an opinion—which was practically very much like something which had fallen from Mr. Maclean—when there was a discussion about the affairs of Afghanistan and there was great fear of approaching trouble, that whatever might be desirable as a temporary settlement any intermediate scheme would not be of any use. He was not a believer in the policy of a "buffer" State, and thought that sooner or later we should have to obtain a permanent settlement, and that probably the true settlement would only come when there was a railway station at which an English train would come in at one end and a Russian train at the other. At that time his sentiments were received with a great deal of abuse, and with charges of want of patriotism, which were readily brought against anybody whom people did not agree with. He was certain, however, that the trend of events had been steadily in that direction ever since, and that they were moving more and more rapidly in that direction now. With regard to Asia Minor, German influence was largely ousting our own. It had been indicated that behind these German and Turkish arrangements there might be circumstances and reasons which it would be rash to attempt to pry into. Lord Salisbury was a great and experienced Foreign Minister, and it was exceedingly probable that there might be some arrangement of which the concession of these German railways formed one part, and some arrangement with regard to Africa might form another. In any case, he was not an alarmist about the spread of German influence in Asia Minor, for he believed the spread of any civilising influence there must be ultimately to our advantage. It was exceedingly difficult to keep out British trade. The great difficulty was our own want of care with regard to certain important educational matters. It was a melancholy thing that now, in Constantinople, nearly all the great English commercial houses had disappeared, and that the trade which not long ago was largely divided between English and other houses, had more and more passed into the hands of others. That was largely owing to what they heard of in the reports from Consular officers all over the world, the want of elasticity in the ideas of English commercial men, and, above all, the absence of a knowledge of foreign languages in the clerks of English houses. We should do infinitely more good by insisting on the spread of commercial and technical knowledge than by raising alarmist cries about the advance of the Russians here or the Germans there.

Colonel Sir THOMAS HOLDICH, K.C.I.E., C.B., having spent a good many years in surveying those districts which were not yet traversed by railways, desired to say a word or two about the alternative routes suggested. He could hardly imagine a German company, or any other, seriously projecting a railway line along the southern coast of Persia. He had surveyed a good deal of it, and one obstacle he might mention which any one could see for himself by taking ship along the coast from Kurrachee. About 150 miles west from there he might see huge cliffs standing out to sea terminating in a square head 2,000 feet high, which would give some indication of the ranges of mountains lying behind; these ranges extended northward into the interior, where they rose to a height of 5,000 or 6,000 feet, and across them there was no way that he knew of. It was true the Indo-Persian Telegraph Company ran its line across, and there was a sort of goat track up and down by which the linesmen could pass; but that range, which in ancient times stopped the retreat of Alexander the Great when he was trying to get to Persia, and led to the destruction of his army, would prove a serious obstacle to a railway along the coast. He was also employed some time ago on the Afghan Boundary Commission, in surveying the country between Quetta and Herat; a country which was exceedingly easy for the alignment of a railway. There were large open sweeps of soft sandy soil, covered with scrub, exceedingly well adapted for sheep, varied by wide spaces of hard gravel, plentifully besprinkled with green oases and big villages, and there was nothing in the shape of a serious mountain range to encounter. He had heard it said that a line between Quetta and Herat would never pay, but if so, it would not be for want of inhabited places through which it would pass. There was the well-known old town of Farah, which had been a centre of trade through all history. North of it was another, Sabrawar, which was the centre of a great agricultural district; and there were many other villages and towns, all of which were centres of local industry, and some carried on a considerable business in carpet making. Notwithstanding the difficulty of crossing the Caspian, he still believed in the junction between Herat and Quetta. He did not underrate the objection raised by military authorities to the proposed line, *i.e.*, that it seemed to give Russia some sort of opening to India, but they had perhaps overlooked the difficulty which would arise from the break of gauge, and overrated the difficulty we might have in holding that part of the country by sending more troops there. As things stood at present th

no chance of making that railway, because the ir would never agree to it. When he did agree should have a right of entry into Afghanistan, and certain extent the command of Afghan troops. h regard to any further extension to the east of the he could not conceive such a connection possible. king to the north-east there was exceedingly ntainous country right up to the Chinese frontier, from Tashkend to Peshawar it would be ossible to carry any line direct, or, if engineers cted to the word impossible, he would say that if line was impossible, that was. Nor did he see necessity for it. From Calais to Moscow, n Moscow to Khokand, and from thence to Merv Herat, with the final connection between Herat Quetta, would bring you to the Indian border h but one break of gauge. Quetta was on the tern side of India, and most elaborate surveys had n made for connections between Quetta and ore, which proved that it was perfectly possible. en Government were prepared to act with Russia the construction of a line between Herat and etta, they would also probably be prepared to con- r the construction of a direct line between Quetta the Panjab.

Mr. F. H. SKRINE said he had had the oppor- ity of studying this problem on the spot two years . He discussed it with General Kurapatkine, and rwards with Colonel Stewart, late Consul-General Odessa, one of the greatest living authorities the geography of that part of the world, and h M. Paul Lessar. He had listened with great rest to the remarks on the development of Indian de, but the story of routes between India and gland had yet to be written. The best attempt in t direction was made in Sir William Hunter's numental "History of British India." He might pardoned for digressing a moment to say that Sir lliam Hunter was one of his oldest and best nds, and he mourned his premature death in mon with all those who came under the influence his sweet and sunny nature. The most interesting pter in a work describing the development of stern trade, would be that dealing with the great way constructed by General Annenkoff be- en the Caspian and Samarcand. Though inally intended for strategic purposes it now opolised the commerce of Central Asia and created an entire revolution in trade; last r more than 250,000 tons of valuable goods g carried on that line. It did not end at narcand, for last year there was an extension le to Kashkend and another almost to the nese frontier, upwards of 400 miles. Again, h from Merv there ran to the border of hanistan, at Kushk, a line of 195 miles length constructed by Colonel Ulianine. need not add anything to what Sir Henry dich had said about that line, for he knew e of it than any man in England, and he had told them that the gap between Kushk and Chaman presented no difficulties. Its length was only 438 miles, less than the distance from London to Perth. Did it not seem monstrous that this trifling gap, which would cost no more than £3,000,000 to bridge, according to the estimate of the Russian authorities, should prevent the completion of a through line to India? When that was carried out they would get into a train at Calais, well lit and warmed, with restaurant cars, and perhaps a library, as on the Siberian lines, and with the exception of the trifling break across the Caspian, between Baku and Krasnovodsk, they would not have occasion to leave the carriage. The journey from Kurrachee to London would be less than a week, and the cost less than a first-class P. and O. fare. Mr. Maclean appeared to advocate a junction by way of Orenburg and Samarcand, but it was not in the con- templation of the Russian authorities to connect Orenburg with Samarcand. To do so would involve a considerable detour, and crossing 800 miles of the most frightful desert in the world. The cost would be at least £10,000,000, and there would be very little intermediate traffic. A junction between Tashkhend and Ishim or Omsk railways, as favoured by Prince Hilkoff, would be preferable; but such questions were quite academic, because if they waited until the trunk lines were joined up they would have to wait until the next generation. The line he advocated was by way of Calais, Vienna, Rustov, Petrovsk, Baku, across the Caspian to Krasnovodsk, and thence to Merv, Kushk, Chaman and Candahar. Of course, there were difficulties, fiscal and political. To enlarge on them would take too much time, but difficulties of what- ever nature would disappear if once the two great powers brought good-will to bear on the problem. Russians and Englishmen were born to respect, and, indeed, to love one another, and one of the reasons they were kept apart was that they saw so little of each other. This railway, by bringing Anglo-Indian travellers to view the glories of Samarcand and the unadulterated East as seen at Bokhara, and to receive the kindness and hospi- tality of Russian garrisons, as he had done, would be one of the most important mainsprings to govern and shape the future policy of the two greatest powers on the Asiatic continent.

Mr. J. W. PARRY said the paper was entitled "New Projects of Railway Communication with India," and of these projects mention had been made of two, namely (1) Orenburgh to Samarcand and (2) from the Bosporus through Mesopotamia to Basra, for the Siberian Railway was too far north to be con- sidered in the direct route to India. Approximately the second project, if not this identical one, he had seen mentioned in the papers at least three years ago, so it could scarcely be called new. He believed various concessions had been obtained from the Turkish Government at different times by various

syndicates for railways through Asia Minor, yet nothing had been done with any of them. Why? If Mr. Maclean would read Lady Blunt's "A Pilgrimage to Nejûd," in the appendix he would find a memorandum in which Mr. Wilfrid Blunt emphasised the fact in no uncertain terms that the country in the neighbourhood of the Euphrates and Tigris was not adaptable for a railway of any kind except at enormous expense. They were, therefore, left with one new project only, viz., the route *viâ* Orenburgh to Samarcand, and Mr. Skrine had pointed out why that should not be adopted. Mr. Maclean said "it needed nothing more than the construction of a few hundred miles through the passes of the Hindu Khush and the Himalayas, and this would be an easy task for modern engineers." An autocratic Government, like Russia, might find the means of constructing such a line, but the task would not be at all easy, for political as well as engineering difficulties must be overcome, and the lives of the engineers and contractors must be protected in an unsafe country: in other words, the cost would be so large that no commercial community was likely to take up such an undertaking in the expectation of it being a financial success unless guarantees were forthcoming; and who would give these guarantees? He would ask Mr. Maclean to be good enough to say who made the survey for the Euphrates Valley line sixty years ago? He was not aware that any engineering survey with levels had ever been made by anyone. General Charles Chesney, or else Sir George Chesney, as also Sir Patrick Andrew, made a reconnaissance of a part, and a part only of the route beginning at Aleppo, but the reconnaissance was not in sufficient detail to make an accurate forecast, while no levels at all were taken. Engineers required levels, and without these indispensable details, any estimates could be little better than guesses—not even approximately true. If the German syndicate were going to continue their line—when made—along the eastern coast of the Persian Gulf to Kurrachee, he wished them every good luck, for they were sure to have plenty of difficulties in crossing the mud-hills in Persia and Baluchistan, as we had had on our Sibi-Quetta lines. He would also ask how many years had passed since "the Shah of Persia made an application to our Foreign Office for the investment of British capital in the construction of Persian railways: but this proposal was treated with contempt." Mr. Maclean from his position in Parliament would be doing the mercantile community a great service by calling attention to this matter. One would like to have a definite answer to the question—Did the Shah of Persia offer any *bonâ fide* inducements or guarantees for the flow of British capital? As to the joining of the Russian and Indian system of railways, *viâ* Herat and Chaman, which Mr. Maclean said many people favoured, he presumed the Government of India, being the most interested shareholder, was not likely to have its claims ignored, and was able to judge when the time was ripe for tl junction to be effected. The gauges of the two systen were not the same, so that transhipment of goo would be necessary at some point. It was said th if there were through communication, the Indi merchants would get an outlet for their goods Central Asia and Persia. Surely Mr. Maclean w aware of the fact that immediately the goo crossed the Russian or Persian boundary hea import duties would be levied on them to favo local manufacturers. If he might make a suggestio it would be that in order to counteract the Germ monopoly, Mr. Maclean or someone else should for a syndicate for surveying with levels a line fro Baghdad to Basra, about 300 miles in length. Tl was a well watered country, and the crops were sa to be excellent, so that such an undertaking ought be remunerative.

Lieut.-Colonel F. S TERRY said—I hold in my ha a letter from Colonel Frazer, R.E., who speaks of paper he wrote, on the subject of daily mails to Ind for the Society of Arts, in 1895. Colonel Fraze proposal was for a railway, 1,000 miles, from Ca and Port Said to Koweit, at the head of the Persi Gulf. Some attention has lately been called to t port of Koweit owing to its large and growing tra and owing to the increasing material interest taken the place by Russia. Colonel Frazer says that comn nication by fast steamers with Kurachi would take o $2\frac{1}{2}$ days, and if the Indian Railway system were tended beyond Kurrachee to Bunder Abbas, in t Straits of Ormuz, the Gulf transit would take only days. By this route, daily mails could be secu out from London to India in seven days. T preference for this route has reference to cert political and military difficulties connected with t Candahar and Russian route. In 1881 I was Candahar and was much impressed with the vi given me by an Afghan merchant of the feeling of t inhabitants of South Afghanistan in relation to th neighbours along the trade routes. He said, "Fr Persia everything good and beautiful comes; to us fountain of art, science, wisdom, and happiness is Teheran. If Persia is agreeable to give any adv tages to Russia Candahar will think that it must for the best to do so. So long as Russia ke friendly with Persia Candahar will be friendly als As regards the Cabul direction the merchant scribed the northern people as brutal and to feared. As regards India he said, "that is a l sunk in the darkness of infidelity." I believe feeling of the Dourani race, who are the leading habitants of South Afghanistan, is as the merchant cribed it to me. This is encouraging enough for Rus The objection to offering international facilities of c munication of a nature useful for military aggres purposes to nations whose principle of governm is antagonistic to our own is obvious. Engla rule is that of the open door of international excha for all that belongs to the arts of peace, and Engl

: world's trustee for this principle. It is, there- necessary for England to be jealous of the ıachments of all nations whose principle of ·nment is that of the shut door. It is a shame nglishmen to echo the cry of those foreigners accuse England of sordid motives in extending nfluence and power in four quarters of the :. She fights for free trade and the open door. is the Pax Brittannica, which means peace and -will for all the world.

. L. R. W. FORREST (formerly President of the ıber of Commerce of Bombay) said the Govern- of India were now engaged in constructing a line urrachee from Delhi, and another line was under deration to join the Bombay and Baroda vay. The line from Delhi to Kurrachee placed atter place at once in communication with the ute centre of India, where all the best produce btained, and he was strongly of opinion that if ne was to be made across Afghanistan it should ade from Quetta to Herat. He did not think Mr. Maclean had made enough of the physical ılties which would beset the line from rcand to Cabul and Peshawar. Some mention een made of the difficulty of breaking gauge, but utside cost in India of breaking gauge was prac- under 2d. a ton, which was not a very serious r, although of course it was a disadvantage, because uired different waggons on both lines. Although fered from Mr. Maclean in his opinion about ilway, he was much obliged to him for the way ich he had called attention to the commercial y of both Germany and Russia. People said that erman Emperor was the best commercial traveller world, and though perhaps they would not ve of the celerity with which he got into friendly unication with the Sultan of Turkey after the nian atrocities, he must say he was much struck he fact that on the death of Mr. Ismay, the pioneer of the White Star Line, who did so to further communication between England America and Australia, he wrote to Mrs. offering her his condolences. He thought s a very wise and prudent thing for an or to recognise what wonderful work for country and for the world in general those rs of steamship communication had done. We great deal just now about the war in Africa; at should we have done if it had not been for nderful transport service which our mercantile as able to place at the disposal of the Govern- He could not agree with Mr. Maclean in his ison of the advantages of railway communica- l sea transport, because the freight from Liver- London was about £1 per ton by rail, and mbay to London by sea it was often consider- s.

C. E. D. BLACK said he wished to say a ith regard to the proposal which had just been mentioned. He had the honour of reading a paper before the Society of Arts three years ago on this project, which he had studied with great care for years, as far back as 1890, when he was in charge of the geographical business of the India Office. It was not the same as Mr. Maclean's, and, briefly, was for the construction of a railway from Cairo across the Isthmus of Arabia as far as the head of the Persian Gulf, the idea being that a railway constructed with British capital should, as far as possible, lie through the British sphere of influence; and certainly the route through Southern Persia to Beluchistan lay more within that sphere than the regions north of that. He did not propose to take up time by re-capitulating what he then said, but with regard to the report of the Committee of the House of Commons which sat on the question of the Euphrates Valley Railway, twenty-eight years ago, he would point out that though that was only a small portion of the land route to India, it was thought worthy of a Select Committee, and that Committee sat for two years. He would suggest, if it were not too presumptuous, that the Chairman might use his influence to get a committee appointed to examine these different schemes. He was quite sure it would be for the benefit of the empire at large.

Mr. MACLEAN, in reply, said his paper was not written in any dogmatic spirit. He did not wish to lay down the law as to what line ought to be made. His principal object was to familiarise the minds of people with the idea of linking the Russian and Indian systems, and to show the advantages which would accrue from it. He was much obliged to the gentlemen who had taken part in the discussion, and who had contributed very useful suggestions. What had been said by Mr. Black was an answer to the remark of Mr. Parry, who said he did not know that any surveys had been made of the Euphrates Valley railway, but it was thoroughly discussed in this country a generation ago, and there was an interesting report of the House of Commons Committee upon it. As to the question about the application to the Foreign Office with regard to Persian railways, he could only say that the communication was made to him by a gentleman high up in diplomatic service, who was himself concerned in making the communication. Mr. Parry had also referred to the taxes which would be levied on goods entering Russia. Of course there would be, but the main idea of this communication was that Russia would get the great advantage of sending her own goods to Indian ports. Naturally, sending her goods there she would be glad to have the advantage of the trade from that part of the world in return. With regard to the open door, he held trade would follow its natural course, and be beneficial to both countries.

Sir GEORGE BIRDWOOD, being called upon to second the Chairman's vote of thanks to Mr. Maclean,

said that at that late hour he would confine himself to remonstrative criticisms. With a Dryasdust student like himself everything was of equal importance, and while he well understood how much the greatness of this country depended on its command of the trade of the East, and the gravity of our losing any portion of it to more pushful rivals, what had really been preoccupying his mind from the moment Mr. Maclean began reading his most interesting and admirable paper, was his misplacement of the comma in the second line of his quotation from Milton. The comma should really be after "barbaric," and not after "kings." Pearls and gold were the unsullied work of God's own hands, and could not be "barbaric;" and the quotation should read:—

> "Or where the gorgeous East, with richest hand,
> Showers on her kings barbaric, pearl and gold."

Then the next thing he desired to reprehend was the remark toward the close of the paper to the effect that the Government of India was so preoccupied "with high politics and high jinks" at Simla, that it had no time to give to such paltry matters as the industrial development and trade of India. It was a cheap sneer, and absolutely unjust and unfair to the Government of Lord Curzon, and unworthy of Mr. Maclean. And what of the preoccupation of members of Parliament, chiefly the Commons, with "high jinks" in St. Stephen's Palace. He never went over to "The House," but, were it winter, the eating-rooms and the smoking-room were crowded; while in the summer, almost every member was to be seen out on the riverside terrace, each one with half-a-dozen, or more, young ladies about him, while he sat feeding their circle of pouting mouths with sugared strawberries! It was always an extremely amusing sight, and accounted for a great deal; and it was certainly not for any one contributing to such an object-lesson of the wisdom of Parliament to talk of high jinks at Simla. At that late hour he would not enter on the weightier matter dealt with in the paper, and would only remark that he did not altogether understand the indifference with which Mr. Maclean treated the independence of Afghanistan. This was not in Mr. Maclean's usual form. Sir George then very briefly, but very cordially, referred to the great work done by Mr. Maclean as editor of the *Bombay Gazette*. They were indeed all proud of him and entertained a warm affection for him on account of his incorrigible intellectual independence and the sacrifices he had made to maintain it.

Mr. W. Martin Wood writes:—During the discussion that followed the reading (on the 8th inst.) of Mr. J. M. Maclean's paper on "Railway Communication with India," scarcely any attempt was made to deal with the fundamental question underlying the whole subject, that is, whether transport between western Europe and our Eastern Empire ("from Calais to Calcutta") of merchandise, passengers, troops, and munitions of war can be as effectually secured by land or by sea? The former method depends on heavy locomotives and cumbrous trucks, involving incalculable friction every mile; the latter is in capacious vessels, the burden being borne by the natural highway of the sustaining ocean. This contrast and comparison was treated of, in masterly fashion, in a paper in the *Contemporary* of last September (by Mr. T. Gibson Bowles). Though not then applied to this particular instance, the argument covers and meets everything that has been, and can be said on behalf of overland railways to India; so that the brief extract subjoined will suffice to supply the missing link in the discussion:—

"The land divides the peoples of the earth; the sea unites them . . . . . Where the sea reaches there human activity is always most to be found; and where the sea reaches not, there all communication with the rest of the world comes least and last of all." [On land, a mountain range, arid desert, a wide river or dense forest, may divide populations living within very short distance of each other; but] "no such obstacles exist on the seas, which afford an ever open road from every point on their shores, to every other point however remote. And as this road is of all the least interrupted of any, so also is it the easiest, the cheapest, and, on the whole, the safest of all; while every day tends to make it safer and its use more certain. Storm and tempest ten times greater than any that Horace ever knew, are now held of so little account that they scarce affect by a few hours an Atlantic passage of 3,000 miles. . . . . "It is suggested that the enormous increase of railways, and the lowering of their rates of freight, must have had, has had, and is having, as a necessary result, the carriage by land of much that was formerly carried by sea, and to that extent a consequent diminution in the proportion of sea trade as compared with land trade. Nevertheless, the very contrary appears to be the fact. The trade by land has no doubt very greatly increased, owing to the circumstances cited; but, simultaneously with that, the trade by sea has increased even more greatly. So that it would rather seem that the more land carriage increased, still the more does it lag behind sea carriage, and still more shows that the sea is destined to be in the future as it has been in the past the one great main road for all trades."

Russia cannot effectively control and trade with her possession in Western Asia without long and costly railways; but we can, with ease, maintain our sway over India and profitable communication therewith by economic seaborne transport. Since the establishment of the Suez Canal, it would be a wasteful and reactionary policy to resort to overland railways for these imperial purposes.

ELEVENTH ORDINARY MEETING.

Wednesday, Feb. 14, 1900; Sir WILLIAM ABNEY, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Daniell, Frederick B., 32, Cranbourn-street, W.C.
Millington, John, Alderman, J.P., The Hollies, Rainbow-hill, Worcester.
Povah, Charles, 18, Exchange-street, Manchester.
Summerbell-Rennie, R. L., M.A., Harleigh School, Bodmin, Cornwall.

The following candidates were balloted for and duly elected members of the Society:—

Birnbaum, Henry B., 3B, Cannon-street, E.C.
Crush, Ernest Hope, 17, Foyle-road, Blackheath, S.E.
Darwin, Major Leonard, R.E., 12, Egerton-place, S.W.
Glass, James George Henry, C.I.E., Tamworth, Mitcham, Surrey.
Greener, C. E., Strelna, Chester-road, Erdington, near Birmingham.
Stocken, Alfred Leonard, Mazères sur le Salat, Haute Garonne, France.
Whitehead, Thomas Ross, Lythalls-lane, Foleshill, Coventry.
Wiener, Louis, 1A Fore-street, E.C.

The paper read was—

DIFFRACTION PROCESS OF COLOUR PHOTOGRAPHY.

By PROFESSOR R. W. WOOD.

The trichromic process of colour photography has already been worked out to a successful issue along a number of radically different lines. We have first the optical synthesis of the three colourless pictures viewed through coloured screens in the Kromskop of Mr. Ives, which has been exhibited before the Society, and it is unnecessary to say that no other method has yet yielded such beautiful or such faithful reproductions of the original. Then there is the triple lantern projection, the lined colour screen of Dr. Joly, the superposed stained films of the Lumieres, and the various colour printing methods, all of which are based on the trichromic idea, and are already too well known to need description. The diffraction process, though it has not yet yielded results comparable to those obtained by some of the other methods, possesses many advantages, and is, so far as I know, the only method which does away with pigments or coloured screens, and which admits of duplication by contact printing.

The scheme by which the colours are produced is exceedingly simple, though it is a little difficult to make it quite clear to those who are unfamiliar with certain optical phenomena. A brief account of the process taken from an article in *Nature*, has already appeared in the *Journal* of the Society; and it may be remembered that the fundamental idea is the production of a coloured picture through the instrumentality of diffraction gratings. As has been said before, the pictures are quite colourless in ordinary lights, consisting of nothing more than fine parallel equi-distant lines on a transparent gelatine film, the spacing between the lines in the different parts of the picture depending on the colour to be produced. We will first consider the theory of how the different colours can be produced by means of these lines, and then take up the practical side of how the lines themselves are produced.

If we place a lamp in front of a lens, and mount a small screen in the focus, we shall have an image of the lamp flame on the screen. Now suppose we make a small aperture at the exact spot where the flame image is, and look through this from behind. Our eye is in the focus and we see the whole lens fill up with a uniform light of dazzling brilliancy. Suppose now we place a diffraction grating before the lens. The grating is nothing more than a plate of glass with several thousand lines to the inch ruled on it with a diamond point, yet it exercises a most remarkable action on the light, somewhat analogous to that of a prism. The different coloured rays of which the white light is made up are bent to the right and left by different amounts, the red being bent the most, the blue the least, and there are seen on the screen, on each side of the lamp flame, spectra or rainbow coloured bands, the blue ends being nearest the flame image and the red the further removed, the other colours occupying intermediate positions. Suppose now that we move the screen until the small aperture lies in the blue portion of one of these spectra. The aperture receives blue light from the whole surface of the grating, and if we look through it we shall see the grating shining with a uniform blue light.

This is the fundamental principle, by which we see the colours of the diffraction photographs. If we push the aperture along the spectrum, keeping an eye at it all the while,

we shall see the grating illuminated in green, yellow, orange and red in turn, as the aperture passes up the spectrum. We can thus see how it is possible to see a field uniformly illuminated in a single colour, by means of a grating. If in some places the lines are not as distinct, that is, not so deeply scratched, these places will appear less brilliantly illuminated, while, if the grating lines are absent on any part of the plate, that part, sending no light to the eye, will appear black. Thus it would be possible to form a monochrome picture with high lights, half tones and shadows, by means of diffracting lines properly distributed over the surface of a transparent plate.

To understand how it is possible to produce a picture showing various colours, we must go back once more to the consideration of the action of the diffraction grating on the light. If we place in front of the lens a grating, on which the lines are ruled closer together, the spectra, or coloured bands produced by this grating on the screen, will be farther away from the central image. If the aperture is in such a position that the red of the spectrum produced by the first grating would fall on it, we shall now find that it is illuminated by green light, and if we look through it we shall see a uniform green field; if the two gratings are placed side by side before the lens, one will appear red and the other green, and if they be made to overlap, the overlapping portion will send both red and green light to the eye, and appear yellow. With gratings we can accomplish what we cannot easily do with pigments, or superposed dyed films, namely, produce a direct mixture of coloured lights. If we have a grating with lines still closer together, it will produce a spectrum still further deviated, and will appear blue when viewed through the small aperture. If on any portion of the plate all three gratings are superposed, this portion will send red, green, and blue light through the aperture to the eye, and will in consequence appear white. Calculations shows that three gratings with 2,000 lines, 2,400 lines, and 2,750 lines respectively, will act in the manner described.

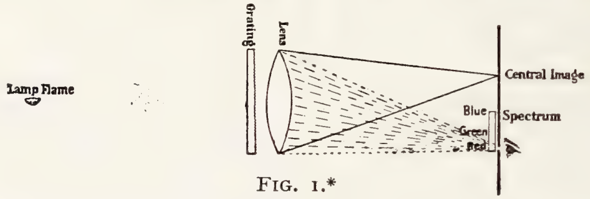

FIG. 1.*
Field uniformly illuminated by a single colour from a grating.

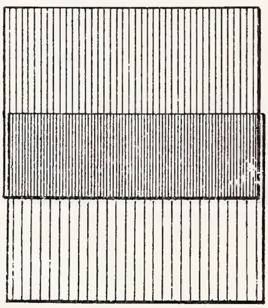

FIG. 2.
Two gratings side by side and superposed showing red above, green below, and yellow in the overlapping position.

Suppose now that we wish to represent a bouquet of different coloured blossoms; the red flowers must have 2,000 lines to the inch, the blue flowers 2,750, the yellow, which we must make by a mixture of red and green, a double set of lines corresponding to the red and green, and the white, all three sets of lines. The shadows and the darker colours must be represented by grating lines, less distinct, and in the dead blacks, the lines are wholly absent. Complicated as this arrangement appears, it can be accomplished quite

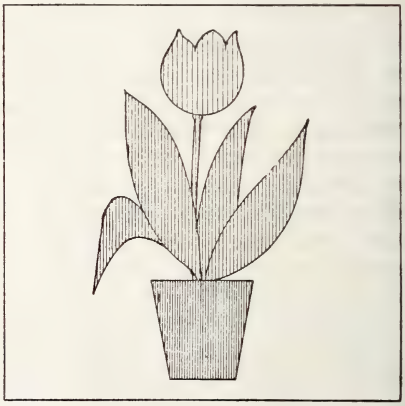

FIG. 3.
Differentially spaced gratings producing different colours.

* Figs. 1, 2, 3, and 6 are reproduced here by permission of the proprietors of *Nature*, who have kindly lent the blocks.

easily, by the aid of photography; for the fine diffraction lines, once ruled on a glass plate, can be transferred to a sensitized film by contact printing.

The three gratings of the proper spacing are first ruled by means of a dividing engine on plate-glass. Three positives made from negatives taken through red, green, and blue colour filters are used for making the diffraction photograph. The principle of trichromatic colour-photography is so well known that a very brief outline of this part of the work will be sufficient. By placing a red glass plate in front of a photographic plate, made sensitive to red light, we obtain a negative representing those, and only those portions of the picture which send light capable of passing through the red glass to the camera. These portions will usually be the parts coloured either red, yellow, or white, and to a *small extent* all lighter parts of the picture. A positive printed from this negative is transparent then in these places. The operation is then repeated with a green glass, and with a bluish violet glass, and the three positives obtained in this way are used in building up the composite diffraction grating which forms the finished colour-photograph. I have obtained my best results by using the small positive pictures made by Mr. Ives for his Kromskop, his screens and plates producing more satisfactory pictures than any that I have been able to make with the colour screens that I found on the American market. I recommend any who have, like myself, given but little attention to the theory of colour filters, sensibility curves, and other details of the trichromatic process, and who desire to experiment on the diffraction process, to begin by using positives made by Mr. Ives or some other expert in this line of work.

The process of printing the diffraction pictures from these positives is essentially as follows:—A sheet of thin plate glass is flowed with a solution of five grammes of gelatine in 125 ccm. water, to which has been added 4 ccm. of a saturated solution of potassium bichromate. The plate should be drained for a few seconds, and set on a level slab to dry, after which it is cut to the required size. I have employed several different methods of building up the composite diffraction grating, which forms the colour photograph, and am at present using the following arrangement, as offering the fewest difficulties.

The three gratings are mounted behind square openings in a thin board, which slides on a horizontal support in such a way that the gratings can be brought in succession into the same position. The positives corresponding to the *reds* of the picture is projected by means of an arc lamp and a photographic objective on to the 2,000-line grating, the ruled surface being away from the lamp. A yellow glass is placed in the path of the rays, and the bichromated plate placed with its sensitive film in contact with the ruled surface. Inasmuch as the projected image can be seen on the grating surface, it is possible to register the position of the plate by means of two or three minute ink dots on the back. The use of the yellow glass is to prevent any transfer of

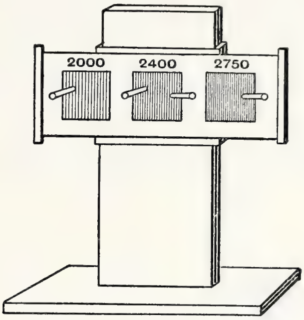

FIG. 4.

Grating support used in making diffraction photographs.

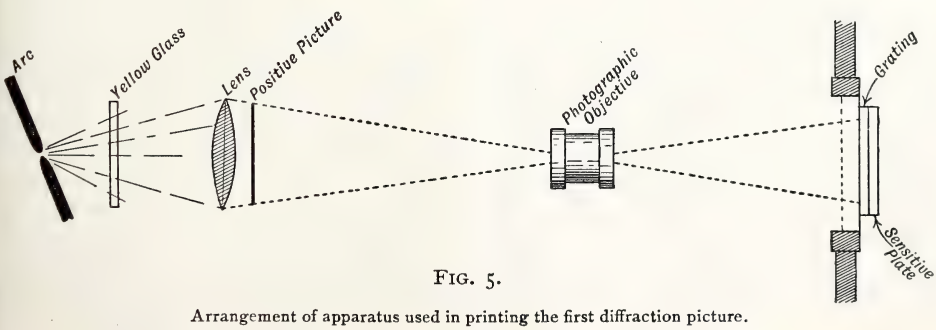

FIG. 5.

Arrangement of apparatus used in printing the first diffraction picture.

the grating lines until the plate is in position and pressed firmly against the grating by means of a spring. An exposure of from one to two minutes is sufficient to impress the 2,000-line spacing on all portions of the plate corresponding to the clear parts of the red positive. The yellow glass is again put in place, the green positive substituted for the red, and the operation repeated, using the grating with 2,400 lines to the inch, registering the plate before the exposure by means of the ink dots. The same is now done with the blue positive and the third grating, and on washing the plate in warm water at 32° Cent., the colour photograph is finished. The picture once formed in this way, can be very rapidly duplicated, by contact printing in sunlight on the bichromated plates, copies being made as quickly and with as little trouble as ordinary blue prints.

To see these photographs in their proper colours, we require a simple viewing instru-

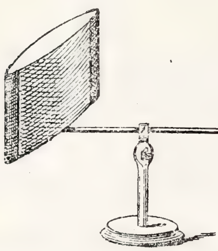

FIG. 6.

Viewing Apparatus.

ment, consisting of a double convex lens on a light frame, with a small screen perforated with an aperture, mounted in its focus. The picture is placed in front of the lens, and the instrument pointed a little to one side of a gas flame or other narrow source of light. On looking through the aperture we shall see the picture in the most brilliant colours imaginable. The disadvantage of having to use but one eye, led me to seek a method for viewing the pictures binocularly. The superposed spectra being formed, both to the right and left of the image of the flame thrown by the lens, if we can arrange matters so that the two points where the red, green, and blue are superposed are at the same distance apart as the eyes, we can employ both sets of spectra, and cut two peep-holes in the screen. This arrangement was found to work very well, but owing to the varying distance between the eyes is impracticable. Mr. Ives, of Philadelphia, suggested to me a very ingenious plan of arranging the grating lines horizontally on the picture, instead of vertically, and viewing the picture through a long narrow horizontal slit, instead of two apertures. Moving the eyes to the right or left would then produce no change in the colour, since the colours are arranged in a vertical instead of a horizonal band. Mr. Ives tried this method, but found it was necessary to employ two horizontal gas flames as sources of light, arranged at just the right distance apart, which is an undesirable complication. I have recently overcome this difficulty by using a viewing-stand with two square lenses, mounted side by side, and a double or stereoscopic diffraction picture, which is viewed

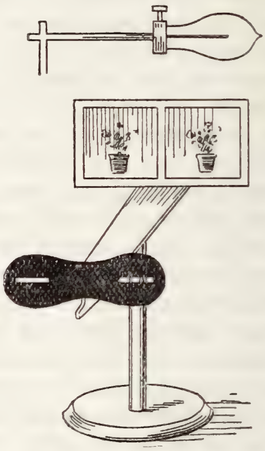

FIG. 7.

Position of lamp and stand for viewing stereoscopic pictures.

through a horizontal slit, in front of which are mounted two thin prisms for combining the pictures. This is by far the most satisfactory form of stand, for we can not only use both eyes, but see the pictures in full stereoscopic relief.

Very promising results have already been obtained, though the distribution of colour is not yet satisfactory. The defects in the pictures thus far made are largely due to the very imperfect gratings that I have had to work with. The spacing of the gratings is not quite uniform, and they have, in consequence, a ribbed or corrugated appearance when placed in front of the lens. These corrugations show in all of the pictures, and are very detrimental to proper synthesis of the colours. A set of perfect gratings has just been ruled on one of Prof. Rowland's engines in Baltimore, but, unfortunately, they were only finished on the day of my departure from America, and I have not had an opportunity of trying them.

A grating, with 2,000 or more lines to the inch, ruled on a first-class engine such as the one at Baltimore, illuminates uniformly when placed before the lens, and is as structureless as a piece of stained glass. As I have said before, the lines visible in most of the pictures that I am at present able to show are due to errors of ruling, the grating lines themselves being of course quite invisible.

There are other ways in which the process may be modified. We may, for example, combine the diffraction method with that invented by Dr. Joly. It is found impracticable to rule coloured lines to the number of more than three or four hundred to the inch; but we may rule as many as 1,400 grating lines to the inch; and by arranging the engine so that it will rule at a variable rate, first a few lines at such a distance apart as to give red, then a few a little closer together so as to give green, then a few still closer together giving blue, we could produce a Joly plate which would appear absolutely structureless. It of course could not be used in the same way. This plate once ruled could be multiplied indefinitely by contact printing; and diffraction pictures could be made from it in several different ways, but as I have as yet made no experiments along these lines, I shall not take the time of the Society in guessing at what may be done. It has been reported in some of the photographic journals that Mr. Thorp, of Manchester, has made and exhibited diffraction pictures showing all the colours of nature by employing a single grating. I must confess that I am at a loss to know how he has accomplished this, unless he has anticipated me and ruled a grating of variable spacing. If he is with us to-night I know we shall be very glad to hear from him.

There are still some difficulties to be overcome, and I do not feel sure that bichromated gelatine forms the best film for receiving the impression of the lines. It is interesting to note the theoretical possibility of producing one of these diffraction pictures directly in the camera, by bringing three diffraction gratings, ruled or photographed on three coloured screens, in succession in contact with the film of a fine grained plate. I have done this already with a single grating, but have not yet attempted the use of all three. Special plates would, of course, be required.

Another peculiarity is that all distinction between positives and negatives disappears. A diffraction picture printed from another is identical with it, both as to light and shade, and colour distribution.

DISCUSSION.

Mr. Thomas Thorp said he was glad to have the opportunity of showing and explaining some of the work he had been doing in connection with colour photography; but he disclaimed any originality in the conception, which was entirely due to Professor Wood. Mr. Butler, of South Kensington, described to him some of Professor Wood's first results just at the time when he was engaged in taking copies of a diffraction grating of about 15,000 lines to the inch, which he was very successful in doing by casting. It had often occurred to him that such films ought to be of use in connection with colour photography; but until Professor Wood showed the way it did not occur to him how they could be utilised. He found it was impossible to take copies of these films on gelatine on account of the closeness of the lines; up to 2,000 or 3,000 lines it was not very difficult, but it was almost impossible to get anything satisfactory with the higher numbers by contact only. Then he added a little glycerine, so as to make the surface tacky, and then pressed the films into the gelatine, this produced a ridgy effect, and they were afterwards hardened by exposure to light. It was an astronomical subject he was dealing with, one of the mountains in the moon; he exposed on it about one and a-half minutes; detached the film, washed it, and got the picture in hardened ridges. Then it occurred to him that he might get three pictures from one grating; he adopted the plan of horizontal lines to begin with, and he tried crossing two sets across the horizontal lines at a slight angle, and downstairs the effect could be seen of a photographic slide which had been printed in this way. He could not, however, print three copies on one plate, he must have three plates. To use a film for each picture was rather troublesome, and he managed to take copies of a picture by simply pouring over it a solution of celluloid, allowing it to dry, and then tearing it off. The results, which could be seen downstairs, were obtained over six months ago and had not been touched since. He wished to show the pictures in the lantern, but found it nearly impossible, and then it occurred to him to design a new set of lines which would allow of this being done, and at the Johns Hopkins University they said they were willing to try to assist him in the matter. He wanted a grating which instead of showing a central image and spectra on each side, would throw all the light into one spectrum, and almost suppress the central image, and in that he had succeeded. By a grating of that character, having fifteen, twenty, or forty thousand lines to the inch he hoped Professor Wood would be able to make pictures which would come out very brilliant. These lines were produced, not by diamond scratches, but by a kind of steam-hammer process, producing grooves of a saw-tooth section 1-20,000th inch in depth and 1-1,000th inch from ridge to ridge. The original metal ruling gave no spectra at all, but when copied in a celluloid casting it acted perfectly, as would be seen on the screen.

Professor Wood said the idea of getting all the light into one spectrum had been sought after for a long time, and Lord Rayleigh in his article on the wave theory in the "Encyclopædia Britainnica," called attention to the fact that if it were possible to produce a form of ruling, such as this saw-tooth pattern, this concentration could be effected. That this had now been done was an exceedingly interesting experimental verification of theory. If you got all the light concentrated in one spectrum it would be possible to project a diffraction photograph with a lantern; but when it was scattered in several supernumerary spectra, the picture was not brilliant enough to allow of that being done.

Professor C. V. Boys, F.R.S., said he must express his admiration for the ingenuity Professor Wood had shown in, first of all, devising such a beautiful method of producing coloured photographs, and, secondly, in overcoming the numerous practical difficulties and making it actually successful. Professor Wood had referred to Lipmann's method of coloured photography as being like a soap bubble film, in which the thickness varied to suit the colour, but it was more than that; it was rather equivalent to a series of soap bubbles—he did not know how many—arranged one behind the other, with the thickness of a soap bubble between each, so that there were alternate films of more or less reflective or transparent material equi-spaced, and it was this constant repetition of the reflecting surface, or dissimilarity of optical property over constant intervals, which produced the extraordinary brilliant effects Lipmann had shown. There was, again, a curious similarity between the Lipmann colour photography and this method, from a theoretical point of view. In each case it was simple, having given the theory, to produce a colour-photograph when you had merely one of the three primary colours, red, green, and blue in any part of the picture, but in both cases it was puzzling how the effect was produced when you had two or three of the primary colours acting at the same spot simultaneously. In the Lipmann case, the fact that there were three series of films, all interlaced at three several distances asunder, occupying the same space at the same time, was so puzzling, that it was hardly possible to imagine how the optical result described could result. Lipmann set to work to obtain a mathematical expression which represented mixed coloured light as met with in nature, and said if that expression were worked out in practice, that light would result; and when he ultimately succeeded in producing the three sets of strata, all superposed and interposed through one another, that result did occur. Here again we had the curious effect of three sets of gratings superposed. He did not know whether Professor Wood felt confident before he tried it, that they would all work independently of one another—he certainly should not have done so, and it seemed to him a discovery, as well as an invention—that they did so act without getting confused with one another. The beautiful result Mr. Thorp had described in the grating the lines of which were not mere scratches, but grooves of a definite pattern, was a practical advance of the very greatest importance in the construction of optical instruments. We had also been much interested in learning that a celluloid film cast of a grating could be made, and he was surprised at the brilliant effect produced. For optical purposes, where the utmost definition was required, it was essential that the grating should be absolutely uniform, and that in no part of it should an accumulated error arise sufficient to bring a line where there ought to be a space. With 1,000 lines to the inch there was no difficulty on this head, but with gratings of 10, 20, or 40,000 lines to the inch it required the highest precision such as could only be obtained by such a machine as Rowland's engine; and it occurred to him to ask whether there would not be a possibility of the film irregularly shrinking or being distorted to an extent sufficient to interfere with its value. He should hardly have thought it possible to avoid this, but if it were, they had here again a method of producing large optical gratings, sufficiently accurate for exact work cheaply, for which they were much indebted to Mr. Thorp.

Mr. Thorp said there was a slight shrinkage in the film, but there was an easy method of testing its accuracy. If the film were reversed and placed on the original grating, you saw certain interference bands, which afforded an easy mode of counting the lines. If there were any imperfect places, these bands would not be equi-distant. He was some months before he could get the bands perfectly equi-distant; but by very careful stoving of the films, they dried absolutely level, and when mounted on good frames they had shown four lines between the D lines. Dr. Ames, of Johns Hopkins University, had congratulated him on their excellence. One of them had 14,438 lines to the inch.

Colonel Allan Cunningham said he understood a ruled grating to consist of a series of ridges and furrows of some definite depth, and he could not understand how photographs and copies of photographs of such gratings could have the same property of diffracting light. Again, he should like to ask if it was necessary when one picture was superimposed on the other, that the vertical lines should be absolutely parallel; what the effect would be if one grating were placed at right angles to the other. If it were necessary that the lines should be truly parallel, how was the register managed. Mr. Thorp had drawn a grating, such as he used, with three sets of lines crossing each other at an angle. He understood that the tilting of the plane on which the lines were, would bring the lines closer together, but he could not understand how their lying at an angle in the same plane could produce the same effect.

The Chairman said he must congratulate Professor Wood on the excellent and clear exposition he

had given of the subject. Mr. Thorp must not take the credit of being the first to have a grating which gave one spectrum only, for he had one about three inches square, which was given him by Professor Rowland, many years ago, which had that property. It was a beautiful grating, and whenever he wanted to photograph the invisible part of the spectrum, beyond the red, he always employed it, because the photographic intensity of that part of the spectrum was so small. Of course there were ghosts of spectra of the second and third order, and on the other side a faint spectrum also, but, practically, all the light was concentrated in one. He believed that was the first grating of the kind brought to England, and the grooves in it, when examined under the microscope, were somewhat of the shape Mr. Thorp had described. This was a reflection grating, whilst Mr. Thorp's was transparent. That was hardly the place to enter on a controversy with regard to Lipmann's photographs, but he must say he preferred Professor Wood's simple description of the matter to Professor Boys's, for although Lipmann had given an equation for the colours in his photographs, the colours which were reproduced were not pure spectrum colours; they were to a certain extent mixed. The method now shown was, to his mind, a more beautiful conception, and he only regretted that Professor Wood, like Mr. Ives, came from the other side of the water. He should like know what light Professor Wood used for taking his photographs, because, to his mind, the difficulty was rather in the production of the originals than in the printing afterwards. With Mr. Ives' principle you could not use a monochromatic beam, you required a large portion of the spectrum.

Professor Wood, in reply, said he knew very little about the colour sensibility curves, or colour filters, and therefore he contented himself with using Mr. Ives's kromograms for printing from, thus sparing himself the trouble of preparing original negatives, because they were far superior to anything he could produce with colour filters which were at his disposal. With regard to the parallelism of the lines, a slight deviation from exactitude made very little difference. If the lines were placed at right angles, one set would diffract horizontally and the other vertically, and the spectra would not be superposed at all; and would not fall on the aperture. With regard to the single grating with lines at different angles, Mr. Thorp would speak for himself; but he fancied that he broke up the light by mirrors into three sources, so that the direction was slightly different, and they were all brought to one focus. With regard to the complicated effect you would expect to get, where two or more gratings were superposed, he was not quite sure; but he thought you got two sets of lines, and in addition shadowy bands, which sometimes, but not often, introduced spurious colour, by acting as lines of wider spacing.

Mr. Thorp said Professor Wood had explained the matter very well. He used three mirrors which acted as sources of light, and by moving the mirrors about you could get any colour you liked.

The Chairman then proposed a vote of thanks to Professor Wood, which was carried unanimously, and the meeting adjourned.

Miscellaneous.

WEST INDIAN AGRICULTURAL CONFERENCE.

The second West Indian Conference was opened on the 6th January last in the Hall of the House of Assembly, Barbados, under the presidency of Dr. D. Morris, C.M.G., Imperial Gommissioner of Agriculture for the West Indies. There were present forty representatives of the Botanical, Chemical, and Educational Departments, and of the agricultural societies in the West Indies. The Governor of Barbados (Sir James Hay, K.C.M.G.) opened the proceedings, and the president delivered an address, in which he dealt with the sugar industry, sugar factories, reduction of cost of production, subsidiary industries (including cacao, coffee, and fruit cultivation), agricultural education and treatment of diseased plants. "A regular plantation of india-rubber trees, the first in the West Indies, is being established at Tobago by Mr. Esmè Howard. The species selected is the Central American rubber tree, locally known as "Vie" or "Caucho" (*Castilloa elastica*). It was recently reported that this tree was found wild in Cuba. This is evidently an error. Rubber trees are being planted in small plantations and in isolated groups, also in Trinidad and Jamaica. The cultivation could be successfully established in some localities in British Guiana, where already one or more valuable species are found in a wild state."

Papers were read at the Conference on the Sugar Industry, on Educational Subjects, Food Supply of the Leeward Islands, Distribution of Plants and Seeds, Bee-keeping in Jamaica, &c.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings at 8 o'clock:—

February 21. — "Artistic Copyright." By Edwin Bale. Sir L. Alma Tadema, R.A., will preside.

Feb. 28.—"Pneumatic Despatch." By Professor Charles A. Carus-Wilson, M.A. Sir Frederick Bramwell, Bart., D.C.L., F.R.S., will preside.

March 7.—"Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources." By Dr. Carl Peters.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S. The RIGHT HON. SIR WILLIAM HART DYKE, M.P., will preside.

MARCH 21.—"The Use and Abuse of Food Preservatives." By DR. SAMUEL RIDEAL.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

FOREIGN AND COLONIAL SECTION.

At 4.30 o'clock:—

FEBRUARY 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. HEDGER WALLACE.

MARCH 20 (Tuesday).—"Imperial Telegraphic Communication." By SIR EDWARD A. SASSOON, Bart., M.P.

APRIL 2 (Monday).—"The Century in our Colonies." By the Right Hon. SIR CHARLES WENTWORTH DILKE, Bart., M.P. The Right Hon. LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., LL.D., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 19...Imperial Institute, South Kensington, 8½ p.m. Mr. Arthur Diosy, "Our Friends in the Far East."

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Mr. P. Boobbyer, "Infectious Diseases."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Mons. Charles Lucas, "The Buildings of the French Exhibition of 1900."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. W. B. Warsfold, "Some Aspects of Ancient Egyptian Art."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor Hull, "African and Mediterranean River Valleys."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Charles Welch, "The Ancient Guilds of the City of London."

TUESDAY, FEB. 20...Society of Designers, Clifford's-inn, Fleet-street, E.C., 8 p.m. Mr. W. G. P. Townsend, "Design for Embroidery."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. Ray Lankester, "The Structure and Classification of Fishes." (Lecture VI.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on papers by (1) Mr. W. B. Farr, "Moving Loads on Railway Underbridges;" (2) Mr. C. F. Findlay, "Note on the Floor System of Girder Bridges."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. J. A. Baines, "Census Taking and its Limitations."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Prof. R. W. Wood, "The Diffraction Process of Colour Photography."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. C. W. Andrews and others, "The Marine Fauna of Christmas Island (Indian Ocean)." 2. Dr. E. Lönnberg, "The Soft Anatomy of the Musk-Ox (*Ovibos moschatus*)." 3. Mr. F. E. Beddard, "A Species of Earthworm from Western Tropical Africa belonging to the Genus *Benhamia*."

WEDNESDAY, FEB. 21...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Edwin Bale, "Artistic Copyright."

Meteorological, 25, Great George-street, S.W. 7 p.m.

Geological, Burlington-house, W., 8 p.m.

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Mr. H. R. Kenwood, "Methods of Disinfection."

Microscopical, 20, Hanover-square, W., 8 p.m. Exhibition of Photomicrographic and Projection Apparatus, with Lantern Illustrations, by J. W. Measures.

Archæological Association, 32, Sackville-street, W. 8 p.m.

Mining and Metallurgy, Geological Museum, Jermyn-street, S.W., 8 p.m. 1. Mr. Otto H. Hahn, "The Development of Silver Smelting in Mexico." 2. Mr. W. B. Middleton, "Segregation of Mine Accounts." 3. Mr. Henry F. Collins, "Notes on a Novel Association of Gold."

THURSDAY, FEB. 22.. Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Carl Armbruster, "Wagner."

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Conversazione at the Galleries of the Royal Institute of Painters in Water Colours, Piccadilly, W.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. H. H. Turner, "Modern Astronomy." (Lecture III.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on paper by Mr. R. F. Sellon, "The Standardisation of Electrical Engineering Plant."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. A. Burchett, "Arrangement and Construction of Picture Landscape."

Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 8 p.m. 1. Mr. Ernest Samuelson, "Improvements in the Longworth Power-Hammer." 2. Mr. Ewart C. Amos, "Portable Pneumatic Tools."

FRIDAY, FEB. 23...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Dr. J. H. Poynting, "Recent Studies in Gravitation."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. B. Humphrey, "Bearing Springs."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, 5 p.m. Prof. R. W. Wood will exhibit and describe his:—1. Photographs of Sound Waves and the Kinematographical Demonstration of the Evolutions of Reflected Wave-fronts. 2. A new Seudoscope. 3. Diffraction Colour-photographs. 4. Artificial Parhelia.

SATURDAY, FEB. 24...North-East Coast Institute of Engineers and Shipbuilders, West Hartlepool.

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. L. Courtney, "The Idea of Tragedy in Ancient and Modern Drama." (Lecture III.)

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FRIDAY, FEBRUARY 23, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS, 1900.

The dates fixed for the Examinations in 1900 are Monday, March 26th; Tuesday, 27th; Wednesday, 28th; and Thursday, 29th.

The Programme of Examinations is now ready. Copies of the Programme, with full details, and an Appendix, containing last year's questions and reports by the Examiners, can be had, price 3d., post free, on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, W.C.

COVERS FOR JOURNAL.

For the convenience of Members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

Proceedings of the Society.

TWELFTH ORDINARY MEETING.

Wednesday, Feb. 21, 1900; Sir Lawrence Alma Tadema, R.A., in the chair.

The following candidates were proposed for election as members of the Society :—

Bird, George William, Moulmein, Burma.
Doman, William, 129, Cheapside, E.C.
Edward, Alfred S., 46, Fountayne-road, Stamford-hill, N.
Williams, B. Robert, Tarquah Government Railways, Sekondi, Gold Coast, West Africa.

The following candidates were balloted for and duly elected members of the Society :—

Badshah, K. J., B.A., 1, Wood-street, Calcutta.
Harker, F. W., 59, Chancery-lane, W.C.
Henderson, John M., jun., King-street Engineering Works, Aberdeen.
Walker, Lieut.-Col. R. S. Frowd, C.M.G., Perak, *viâ* Penang, Straits Settlements.

The paper read was—

ARTISTIC COPYRIGHT.

By Edwin Bale.

Life and property are in this country the two most sacred things in the eye of the law. There can never have been much doubt as to what was meant by life, but as to what might be covered by the terms property the discussions have been many and long. When the thought first began to take shape that a man might claim property in ideas, it was strenuously opposed by the lawyers, who maintained that property could not exist in such intangible matters. Money, real estate, things that could be handled and passed on to one's heirs, these things were property. And long after the rights of an inventor in his ideas and the form in which he put them had come to be recognised, discussion raged in England and in France as to whether those rights were really property rights or rights acquired by privilege. If they were rights of property they must endure and be unaffected by lapse of time, and this was the contention of the first claimants of copyright or property in works of human intellect.

Long before there was any thought of statutory copyright in works of art there existed statutory copyright in literature, but curiously enough the copyright did not rest in the author. All works in order to be protected had to be registered at Stationers' Hall, but no one was competent to effect a registry but a member of the Stationers' Company, so that an author was compelled to sell his work right out to a bookseller, as publishers were then termed, who being a member of the Stationers' Company could register the work. Once registered the bookseller claimed perpetual copyright, and at his death his rights were disposed of to another bookseller who carried on the tradition. In the year 1748, a Mr. Johnson bought the bookselling business of a Mr. Clarke, for which he paid £2,000, one-half of which sum he stated was for the purchase of copyrights. Amongst other things he claimed as the result of this purchase, a perpetual copyright in and ownership for ever of a work called "The Pilgrim's Progress," by one Bunyan.

But in 1774, a decision in the House of Lords made it clear that neither public opinion nor law would recognise copyright as property in this sense, and from that time it has been accepted that copyright is not a property in the ordinary sense, that it is a

right which exists only by statute, and that its terms and conditions and period of duration depend entirely upon Acts of the Legislature, and are liable at any time to modification and alteration at the will of Parliament.

The first copyright Act ever passed in this country was in the reign of Queen Anne, and was for the protection of writers and writers only. It was not until the reign of George II. that any step was taken to protect the artist, and a Bill was passed through Parliament actually in the interest of one man.

William Hogarth, one of the most distinguished men of genius the English School of Art can claim, was engraver as well as painter, and he devoted enormous time to putting his inventions into the form of engravings, only to find that no sooner were these issued than his market was seriously damaged by the competition of very inferior copies issued by other engravers or publishers. It was to prevent these piracies of Hogarth's engravings that an Act, which came into force on the 24th of June, 1735, provided that "every person who should invent and design, engrave, etch, or work in mezzo-tinto or chiaro-scuro, any historical or other print or prints, should have the sole right and liberty of printing and representing the same for the term of fourteen years, to commence from the day of the first publishing thereof, which shall be truly engraved with the name of the proprietor on each plate and printed on every such print or prints." The penalty for piracy was the forfeiture of the plate and all prints, together with 5s. for every print so pirated.

It is important to notice the principle of this first Art Copyright Act. It protected only the inventor who carried out with his own hands his own invention, and no provision was made for the protection of the engraver who was not also the designer.

In 1766, thirty-one years later, in the reign of George III., a second engraving Act was passed "to amend and render more effectual" the aforementioned Act, and "for vesting and securing to Jane Hogarth, widow, the property in certain prints." This Act extended protection beyond the designer who also engraved, to any person who, although not being himself the designer, made or caused to be made an engraving from any picture, drawing, model, or sculpture, either ancient or modern.

The great man for whose protection the first Act had been brought into existence had passed away, leaving poor "Jane Hogarth, widow," as the Act curtly designates her, to face the almost immediate termination of the all too short 14 years term of copyright, and the consequent loss of her livelihood. To secure to "Jane Hogarth, widow," her property in certain prints, this Bill extended the term of copyright to 28 years.

But the good, honest Englishman of the period still contrived to get the better of these Acts, which threatened him with penalties if he stole other persons' ideas, and a practice grew up of taking designs, and by adding to them, or taking from them, or both, and producing fresh engravings, making it appear that they were new works, and it became necessary, in 1777, eleven years after the passing of the last Act, to put through another short measure, still further to protect the engraver, by prohibiting the copying *in whole or in part* (a clause not contained in the previous Acts), by varying, adding to, or diminishing from the main design of an engraving, without the express consent of the proprietor or proprietors thereof, and it gave the proprietor the right to sue for damages against a person so offending. And that is, shortly, the story of the three Engraving Copyright Acts. It is, however, necessary to add that in 1852, in an International Copyright Act, it was declared that the provisions of the Act, "and the Engraving Acts collectively, are intended to include prints taken by lithography, or any other mechanical process, by which prints or impressions of drawings or designs are capable of being multiplied indefinitely."

After the engravers the sculptors. At this distance of time it is difficult to understand the zeal of legislators for this branch of the Arts. It is true that at the beginning of the century what interest there was in art went out in the direction of classic tradition, of which evidence was to be seen in the costume of the period of the French Revolution, and it may be that because the sculpture of the period embodied the classic tradition more than other branches of the arts, it was felt to be the highest form of art and the most worthy of protection. But whatever reasons may have been operative, one year and one month before the battle of Waterloo, that is to say, on the 18th of May, 1814, the present Sculpture Copyright Act came into operation, giving sculptors copyright in their works.

The term of copyright was to be for fourteen years, with the proviso that should the author be still alive he should enjoy a further period of fourteen years, the copyright returning to

him should he have disposed of it for the first period.

The copyright was to date from the "first putting forth or publishing the same," whatever that might be held to mean, but the uncertainty of that clause was governed by the added condition that the proprietor must put his name with the date upon every work before putting it forth or publishing it.

A curious and interesting interpretation of this Act is that the law does not regard a photograph, drawing, or engraving of a piece of sculpture as being a copy of it. To infringe the copyright of a piece of sculpture it must be copied by another piece of sculpture. The list of matters protected by the Act is very detailed, and includes casts from nature. Whether owing to the honesty of the sculptor or to his peaceable nature the law has seldom been appealed to.

At last came the turn of a third set of subjects—Painting, Drawing, and Photography. Anyone interested in the subject of copyright, reading the recently published life of Sir John Millais by his son, must have been struck by the way copyright difficulties are referred to by the painter in his early letters. He had constant difficulties in disposing of his works because of the difficulty of arranging matters as to copyright, or indeed of knowing how he stood with reference to the copyright in his pictures. The truth was that there was in his pictures at that time no copyright at all, and that while an engraver could, by the Engraving Acts, create a copyright in his reproduction of a picture, the artist himself, the creator of the work, had no rights except such as the common law afforded him. For consider what is copyright? It is not merely the right to copy, it is the sole and exclusive right to copy, and the difficulty the painter had to face was that unless he could dispose of his work to someone who would arrange to engrave it, and so to occupy the market, on the picture being made public it might be pirated. It is difficult to realise that this condition of things should have endured right down to a time well within the memory of many of us present. It was not until the year of the second International Exhibition in London, the year which saw Captain Fowke's great brick exhibition building erected at South Kensington on the ground now occupied by the Natural History Museum, the year after the death of Prince Albert, that is to say, not until July 29th, 1862, that the law came into force, the preamble of which begins as follows :—"Whereas by law, as now established, the authors of paintings, drawings, and photographs have no copyrights in such their works, and it is expedient that the law should in that respect be amended. Be it therefore enacted," &c. And so it comes about that there is no copyright in any painting, drawing, or photograph executed and dealt with before the middle of the year 1862. It is a fact, somewhat difficult of realisation, that some of the most important works produced by the pre-Raphaelite brotherhood, by Sir John Millais, and Mr. Holman Hunt who is still with us, have not, and never had any legal claim to copyright protection.

The term of this 1862 Act differed from its predecessors by being made dependent on the life of the author, to which life seven years were added. In the Literary Copyright Act, there are two terms—the life of the author and seven years, or forty-two years, which ever may prove the longer. But in taking a fixed term like forty-two years, it is necessary to have something to start from, and with a literary work it was easy to start from the date of publication, and there was consequently no difficulty in giving such choice of terms. But there exists no such thing as the date of publication of a painting; although in the endeavour to bring painting and literature under one Act, attempts have been made to invent for the purposes of the law some action, which should be called or considered as publication. But the difficulty was evidently before the author of this Act, and the artist's term was made his life and seven years after his death, without any alternative. This term applies, of course, equally to photographers.

A most important point arises in answer to the question, in whom is the copyright vested. The Act says "the author," and the Courts have decided, that as regards photography, that is to be taken to mean the person who takes the negative, not the person who employs him, but the operator himself. A case came before the Courts in which a firm, consisting of two persons, employed a number of photographic assistants. One of the managers, thinking that a photograph of the Australian cricketers would find a good market, made arrangements with the cricketers to photograph them without charge, and the firm sent one of their photographic operators to make the negative, which he did, and prints were taken from it in the usual way. The photograph was pirated, and the firm who had registered themselves as the owners of the copyright, brought an action for infringement;

but it was held by the Court that the assistant who actually took the negative was the author of the photograph, and that its registration in the name of the firm was consequently null and void. There are other cases bearing on this ruling.

The ownership of the copyright is not so easily settled, and I must ask you to bear with me while I read the clause of the Act, which runs thus:—

"Provided that when any painting or drawing or the negative of any photograph shall for the first time after the passing of this Act be sold or disposed of, or shall be made or executed for or on behalf of any other person for a good or valuable consideration, the person so selling or disposing of, or making or executing the same, shall not retain the copyright thereof unless it be expressly reserved to him by agreement in writing, signed at or before the time of such sale or disposition by the vendee or assignee of such painting or drawing or such negative of a photograph, or by the person for on whose behalf the same shall be so made or executed; but the copyright shall belong to the vendee or assignee of such painting or drawing or of such negative of a photograph, or to the person for or on whose behalf the same shall have been made or executed; nor shall the vendee or assignee thereof be entitled to such copyright unless at or before the time of such sale or disposition an agreement in writing signed by the person so selling or disposing of the same, or by his agent duly authorised, shall have been made to that effect."

That is to say, after promising the author copyright in his work for his life and seven years, the Act goes on to say that in order to get it, when he first sells or disposes of his picture he must say to the intending purchaser, "There are two properties in this work—the picture and the copyright; I am only selling you the picture, and must ask you to sign a document reserving the copyright to me." And if the artist does not take this step and get this document, the Act gives the copyright to the purchaser of the picture, but, with a proviso, and this time the purchaser to whom this generous gift has just been made gets his cold douche, for in order that he may have the copyright he must have a document, signed by the artist, reserving the copyright to him, and if neither of these things is done, and no document is signed, the copyright does not belong to either the artist who sells or the client who buys, and the Act is silent as to whom it belongs. It has disappeared, and belongs to no one; there is no copyright existing in the work for anyone.

Those who know anything of the delicate nature of the transaction often involved in selling a picture will readily understand how an artist, unless he holds a very high professional position—and that is not always a protection—shrinks from the mention of the copyright question lest he should not only fail to dispose of the copyright but lest the sale of his picture may be interfered with, and in far and away the majority of cases, for this reason, the painter sells his work, says nothing of the copyright, and loses it. I once remarked to one of the best known picture dealers in London that probably as the result of these provisions 99 pictures out of every 100 are out in the world without any copyright protection, to which he rejoined—"I should rather think 999 in 1,000 would be nearer the mark."

The photographers are not affected by these clauses because they do not, as a rule, sell the negatives they produce; they can carry on their trade in prints without the question of the negative arising, and so they have the protection they require in this particular. The picture dealer also, who buys a picture and copyright, is not subjected to the same disabilities as the painter. The picture dealer can sell the picture without saying a word to his client as to the copyright, which he nevertheless retains intact; for the provision is applicable only to the "first sale" of the work, which throws the whole of the disability on the painter.

It is difficult to understand how it came about that this Act, which was initiated for the benefit of the painter only, should have put him in so bad a position. One has, however, to remember that although the artist is prone, and quite naturally, to speak of his rights in the matter of copyright, there is a strong tendency on the part of legislators looking at these same rights from the point of view of the public to regard them as monopolies to be jealously watched. The artist is apt to think the matter concerns himself only, but it cannot be made too clear that the interests of the public are very real, and that it is the duty of the men who make the laws to guard the public interest.

In the present case it was probably excess of zeal in this direction which caused the Bill in its passage through Parliament to be amended and amended until the very object with which it set out was defeated, and the law made practically inoperative for the protection of the painter's copyright.

I said just now that this Act was originally initiated for the protection of the painter only. I believe it was, so to say, an accident that it came ultimately to include photographs. It

was thought that they were protected by the Engraving Acts with the addition of the clause covering lithographic prints taken by any mechanical process, and the inclusion of photography was not originally contemplated, but the photographers feared that their prints being of a different character from those taken from engraved plates or lithographic stones might not be protected, and ultimately photography was included.

To pass to other provisions of the Act which must be mentioned. It gives the copyright of a work executed on commission to the person by whom it is commissioned.

It makes it compulsory upon every owner of a copyright that he should register it at Stationers' Hall before he can take any action at law to protect it. A copyright does not lapse if unregistered, on the contrary it remains perfectly good, but so long as it remains unregistered no action at law can be taken on account of an infringement. A copyright can be registered at any time, even after an infringement, but the owner of a copyright cannot recover for any infringement before registration.

The Act provides for both penalties and damages. The cases giving rise to both or either of them are as follows:—

1. For infringing copyright in the ordinary way by issuing unlawful copies.

2. For fraudulently signing or affixing a fraudulent signature to a work of art.

3. For fraudulently dealing with a work so signed.

4. For fraudulently putting forth a copy of a work of art, whether there be copyright in it or not, as the original work of the artist.

5. For altering, adding to, or taking away from a work during the lifetime of the author, without his consent, and putting it forth as the unaltered work of the author.

6. For importing pirated works.

This Bill had hardly passed into law before its incongruities became apparent, and efforts were made to have it amended. The very next year a new Bill was brought into Parliament, and year by year the effort was unrelaxed, until at last it was found desirable to have the whole question of copyright reconsidered, and a Royal Commission was appointed to take evidence and report. The Commission sat and took evidence during two Sessions of Parliament.

Their report, a most valuable document, was issued in 1878. Every effort for reform since that date has been more or less based on that report. Unfortunately, as in the case of so many other Commissions and Committees, nothing came of the report, and efforts from the outside were continued until the unhappy "eighties," when Irish affairs stopped all domestic legislation and copyright was hung up. Within the last four or five years it has been in the air again, and all unknown to each other three separate committees were at work —the Authors' Society dealing with literary matters only; the Copyright Association which essayed to cover the entire field of copyright in one inclusive Bill; and the Artists' Committee which dealt with art only. The Authors' Society and Copyright Association had their Bills presented to the House of Lords, the one by Lord Monkswell, the other by Lord Herschell, they both were read a second time, and referred for consideration to a Committee of the House of Lords, under the presidency of Lord Herschell. The Artists' Bill having been meanwhile drafted, the President and Council of the Royal Academy requested Lord Monkswell to introduce it, and it also was read a second time and referred to the same Committee.

With the three Bills before them the Committee came to the conclusion that it was desirable to put on one side the inclusive Bill of the Copyright Association, and to deal separately with literature and art, and they asked Lord Thring, one of their number, to draft a Bill for literature, accepting the Bill of the Royal Academy as the basis of their inquiry on art.

This Committee of the House of Lords has already sat for two Sessions and they propose to ask to be re-appointed for the present one, in which to continue their inquiry.

I trust I have thus far succeeded in giving you an intelligible idea of the history of artistic copyright down to the present moment, but it remains for me to review the whole result, and to ask—How does the matter stand to-day?

We have five Acts. Three deal with engraving, one with sculpture, one with painting, drawing, and photography, between which there seems to be little or no relation. We have, first, three terms of duration of copyright—28 years for an engraving, 14 for sculpture, with a second 14 if the artist be alive at the end of the first; life and seven years for a painting, drawing, or photograph.

There are two different relations of the artist

to his copyright. The sculptor's right to sell his work and retain his copyright has never been questioned. The retention of the painter's copyright is made to depend upon the signing of a document by the purchaser of his work.

Two modes of treating artists as to registration also exist. The engraver and the sculptor comply with the law by putting their names and dates on their work and they are not required to register. The painter cannot protect his copyright without registration; while registration itself, as it is now required, is a snare, a delusion, and a pitfall. Designed to give the public information as to ownership and duration of copyrights, the uncertainty of its operation simply results in the prevention of information on these very points.

And now we come to the consideration of the proposed new Artistic Bill. As its memorandum states, it "is intended to simplify and amend the law relating to copyright in artistic works. Its main features are—

1. To secure greater uniformity in the terms and conditions of copyright.

2. To reserve to the artist—with certain exceptions—the copyright until expressly assigned or disposed of by him.

3. To make registration of copyright—and of all dealings therewith—with certain exceptions compulsory.

4. To improve the remedies for infringement.

To artists, its most important section is that dealing with the passing of the copyright from the author. It is proposed that the copyright shall remain with him notwithstanding the sale or disposition by him of the work until expressly disposed of by him in writing. The copyright of a work of art and the work itself are too such distinct properties, of which it occasionally happens that the copyright is far the more valuable of the two, that it is hardly necessary to spend time in showing the injustice involved in making the two properties pass as the result of the sale of the work. The report of the Royal Commission recorded the fact that "the artists as a body are unanimous in their desire to have the copyright reserved to them by law," and that desire is as strong to-day as it was when, the Commission recommending otherwise, the Royal Academy at once entered its strong protest to the Government against any other method of dealing with the artist's copyright. The Bill proposes that the purchaser of a work of fine art should not thereby acquire the copyright unless he expressly contracts so to do. And here, two questions naturally occur:—

When a portrait is painted on commission, is the artist to retain the copyright?

He is unless the contrary is expressly stipulated, and the person giving the commission can always stipulate as to the copyright if he desires it, but in order to protect such a person, the Bill provides that, in this case, although the copyright remains with the author, he may not, without the consent in writing of the owner of the portrait, reproduce it in any way. This clause restricts the exercise by the artist of his copyright, in the interest of the owner of the portrait, but it enables him to veto the issue of bad reproductions of his work, which might injure his reputation.

The second question is—Retaining the copyright of a work he has sold, may an artist repeat the work to the injury of the purchaser? Under the present law, with the vanishing copyright, the artist may repeat the subject as often as he pleases, and I remember a very interesting discussion between two eminent picture collectors before a well-known picture hanging in the gallery of one of them, as to which of them owned the original, they having both bought the same subject from the painter. Under the new Bill this cannot happen. Replicas which could interfere with the identity of the original work are forbidden to the artist, though he retains the copyright. This is in the public interest.

The next change of importance proposed by the Bill, concerns the terms of copyright.

There are two terms of copyright conferred by the Bill:—

(1) For an original work of fine art, the life of the author, and thirty years after his death.

(2) For a work of fine art made by one person from the design of another; for a photograph, for a cast from nature, thirty years from the first day of the month of registration.

There can be no kind of doubt that, under the existing Act, the artist is placed in a position of great disadvantage when compared with the photographer, and the proposal of the new Bill is to do away with those disadvantages, and, taking into consideration the differences which exist between various forms of art and photography, to devise a term of copyright protection which shall meet the needs and circumstances of all of them without injury to any.

Works of art divide themselves naturally into two classes, the division between which is an intelligent one and readily perceived.

An original work of art is, from its inception to its completion, the work of the artist; imagined and thought out by his brain, and embodied in some graphic or plastic form by his hands. The highest art is the expression of a thought or feeling in forms suggested by nature and put into shape with the skill of the craftsman. Art and nature are quite distinct things. Art is nature that has passed through the alembic of the artist's brain, and has been embodied by his hands; and there is a clear distinction here between such original work, and the translation of such works after they have been produced into some other form by engraving or other similar process or the mere reproduction by mechanical means, like the casting of simple natural forms; this is a distinction not of better or worse, but merely of kind, and this difference of kind is of vital importance. The man who works with high artistic aims has almost always to work and wait for long and perhaps weary years before he commands his public. The painter, the sculptor, the inventive engraver, works not for the public but for himself. He works at subjects that please himself, and in a manner which he alone approves. He has to educate his public before he can reap his reward, often he never reaps it, and still more often it is not till he is well on his career, and close upon the end of his life, that his works have any copyright value. The photographer, the translator engraver, who mainly works on commission, enters upon his harvest at once, and the difference of terms proposed in this Bill is to give the children of the artist some chance of reaping what the father in his lifetime failed to win.

The difference in this and other respects between the photographer and the painter was recognised by the Royal Commission, who themselves recommended the proposed difference of terms in the following words:—

"We therefore propose that the term of copyright for all works of fine art other than photographs shall be . . . . the life of the artist and 30 years after his death." [C. 95.]

"Photographs, however, present some difficulty. At the present time they are coupled by Act of Parliament with paintings and drawings, and are subject to the same law; but as we have before pointed out, we believe this circumstance arose merely from the fact that before 1862, when the Act was passed, there was no copyright protection for either of these subjects, and it was then thought right that photographs should be protected as well as other works of art. On consideration, however, it will be seen that photographs are essentially different from paintings and drawings, inasmuch as they more nearly resemble engravings and works of a mechanical nature by which copies of pictures are multiplied indefinitely." [C. 118.]

"We propose that the term of copyright in photographs should be 30 years from the date of publication." [C. 119.]

But it must be asked does the proposed extension of terms to the artist do injustice to any one? At present photographs have life and 7 years of the operator, the engraver 28 years, the caster from nature 14, and a possible other 14 years. It is proposed to give to each a fixed term of 30 years. At present the photographer has an uncertain term which may end in 7 years and a day, and I am not aware that any one has objected that the term of 30 years is not as good, if it be not better, than the uncertain life of the operator and 7 years. With the other two cases the term is an actual extension on what they now enjoy. In considering this question it is well to look abroad and see how it is dealt with in other countries.

In France, the artist has a copyright for his life and 50 years. A photograph has not of necessity a copyright at all; but if it can be shown that it is artistic in its character, it can claim protection as a work of art. In Germany, Austria, Hungary, Norway, Sweden, Denmark, Spain, Portugal, Switzerland, the artists' term varies from life and 20 years to life and 50 years. The term for photographs is a uniform one of 5 years only.

Registration is the next important matter dealt with in the Bill. The primary object of this is to afford information to the public as to the ownership and duration of copyright. Under the present Act, the owner of a copyright must register if he wishes to take proceedings for an infringement; but in practice a large number of copyrights go unregistered. The public, who are unversed in the ins and outs of the law, do not understand this; and, indeed, those who do are in little better position. You want to find particulars as to some work, and you search the register, there is no entry. Knowing the condition of the law which causes so many copyrights to lapse, the presumption is that the work is within the "public domain;" and if so, it is actually public property, and any one may use it. At the same time, you know that if you do, it is at your peril, for an unknown and undiscoverable copyright owner may suddenly appear out of space, and having registered his work after your publication, may obtain an injunction and stop your work. Now it must be manifest that

to leave things at a loose end like this is fatal. Registration must either be abolished, and the public left without pretence of information, or it must be made compulsory. Once more one looks back to the report of the Royal Commission, and this is what we find:—

"We are satisfied that registration under the present system is practically useless, if not deceptive." [C. 137.]

"We have been satisfied by the arguments in favour of registration, that it is advisable to insist upon it, and that it should be made more effective and complete. To this end it should be made compulsory." [C. 138.]

This recommendation is embodied in the Bill.

But the Bill exempts from registration the copyright of an original work of Fine Art so long as it remains in the possession of the author, but should he dispose of it the person to whom it is assigned must register. The reason for this is simply that as under the Bill the copyright is always vested in its author until disposed of, if there is no entry of a work the public will know that the copyright is still in the hands of the artist and will apply to him for information, and this method is made effective by the compulsion to register within six months after it leaves his hand.

But the onus of registration remains with photographers, engravers and others, who under the Bill have a fixed term of copyright. This becomes a necessity because this term starts from a certain date. Under the Bill it is date of registration and the public have a right to know when that term begins and ends, and in England registration is the only accepted means of affecting this. In foreign countries a system is adopted whereby photographs have to be issued stamped upon the face with the name of the firm to whom they belong and the date of original issue, so that the public may see at a glance how many of its five years have expired. There is a special reason why in the public interest photographs should have a fixed term which should be registered, a reason which does not apply to original works of Fine Art.

Under the present law the copyright of a photograph is vested in the operator for his life and seven years; but, assuming that the copyright is registered in the name of the operator, what means has the public of knowing anything about him? He is an employé, unknown to the public, who passes maybe from the service of one firm to another, and passes ultimately away, and even the person who employed him may know nothing of his end. It is probable that at the present moment there are thousands of photographs upon the market in which copyright is claimed, the rights in which have long since expired under the terms of the present Act. The present Act is, and any Act giving life and a term of years to the photographic operator must be ineffective, owing to the conditions of the photographers' business. That this should be so is scarcely in the public interest.

Turning once more to the report of the Royal Commission, we find, after the proposal of compulsory registration,

"We recommend that registration of paintings and drawings should not be insisted on so long as the property in the picture and the copyright are vested in the same person, but that if the copyright be separated by agreement from the property in the picture there should be compulsory registration." [C. 158.]

"With regard to such works as engravings, prints, and photographs . . . . We think that they should be subject to compulsory registration." [C. 159.]

I have put before you the main features of the Bill. There are others I can only mention:—

The Bill enables an American to secure copyright in this country. At present he cannot do so, while we can secure copyright in America.

It attempts to simplify and make clear the relation between an employer and his assistant whether he be employed to make a photograph, or to assist in carrying out a work of art, in which cases it is proposed that the copyright remain with the employer.

It defines more clearly the relation between the publishers who employ an artist to draw or a photographer to photograph for publication. It amends and strengthens the provisions for repressing the commission of fraud, and gives to the print-seller, the photographer, and fine art publisher, powers of which he has long felt the need, and for want of which he has been largely at the mercy of the pirates, viz., power of search and seizure of pirated copies in houses and shops, and on hawkers.

These are powers which were also recommended by the Royal Commission.

In so far as they can claim to be works of art the Bill protects the drawings of the architect, and the designs of the art worker in all materials. It does not directly concern itself with International Copyright, nor with the Berne Convention, though indirectly it touches

both, and these subjects are far too wide for me to enter upon.

I have tried in the time at my disposal to give you a brief sketch of the rise and progress of artistic copyright, to show you the weak spots in the present state of the law, and the reasons for the chief proposals made in the new Bill now before Parliament. As a matter of fact it is a subject which concerns pounds, shillings, and pence only; it is a mere question of business; and yet I know of no question into which more sentiment can be and is imported. And one knows what a weighty factor is sentiment. Its introduction, however, only interferes with a true perception of the real matters which have to be considered, but painters, and sculptors, and engravers, and perhaps I shall not be far out if I add photographers, have all a good deal of sentiment about them. Sentiment is a fine thing, it belongs to the highest in man, but it is out of place in such a mere matter of business as copyright. It is as a matter of business that the Bill will be dealt with by the Committee of the House of Lords, and as a business measure it will have to pass through the fire of criticism not only before the Committee but before Parliament. And only if it can stand this test will the Committee which is answerable for its existence feel they have succeeded in that which was their main object in framing the measure.

DISCUSSION.

The Secretary read the following letter from Mr. BASIL FIELD:—As I cannot be with you to-night, I send, as requested, a few short notes that may serve as prologue to your proceedings. I am the more sorry that age and infirmity prevent my attendance in person, as the Society of Arts is the historic birthplace of art copyright. With the exception of an abortive attempt on the part of Serjeant Talfourd, in 1842, to include art copyright in his Act, the first Parliamentary measure claiming copyright for the artist painter was prepared under the auspices of the Society of Arts. This Bill was originally an Amendment and Consolidation Bill, dealing with engraving and sculpture as well as with painting, drawing, and photography. It failed to pass; and on the advice of Sir Richard Bethell was cut down to a modest measure dealing with painting, drawing, and photography alone. In this form it was re-introduced to the House of Commons by the then Attorney-General, Sir Roundell Palmer, but was so crippled and maimed in its passage through that House, that its promoters seriously thought of abandoning it altogether. With a view to possible amendment in the House of Lords, I went with your Secretary (the late Mr. P. Le Neve Foster) and others to wait on Sir Richard Bethell, who had by that time become Lord Westbury, and, as Lord Chancellor, had charge of the Bill in the House of Lords. He strongly urged us not to drop the Bill nor to imperil its passing by attempted amendment, but to let it go through in any state, however imperfect. "Get the right once recognised," said he, "and you may hope to get the incidents and conditions of the right put on a more satisfactory footing hereafter." This advice, which was confirmed by the opinion of Sir Roundell Palmer, was followed, and the poor mutilated Bill of the Society of Arts became "An Act for amending the Law relating to Copyright in Works of the Fine Arts, and for repressing the Commission of Fraud in the Production and Sale of such works, 25 and 26 Vic. Cap. 68, 29 July, 1862." Its main object was to give to the man who expresses his thought with a brush, the same rights and protection as were already afforded by law to the man who expresses his thought with a pen, with a chisel, or with a graving tool. Portraiture—especially photographic portraiture—was the rock on which this Act was damaged, and on which all subsequent amending Bills have been stranded or totally wrecked. "It is all very well to give an artist copyright over the imaginative creation of his brain," said our legislators, "but what is to prevent photographs of our pretty wives and daughters being exhibited for sale in the shop windows, in company, may be, with those of so-called professional beauties?" Then it was remembered that portraits were almost always commissioned work; and accordingly—in spite of the preamble reciting that "by law as now established the authors of paintings, drawings, and photographs, have no copyright in such their works, and it is expedient that the law should in that respect be amended," and in spite of the preliminary declaration that the copyright shall belong to the author for his natural life and seven years—the very first section of the Act at once proceeds to enact the exact contrary in the case, not only of portraits but of all commissioned work, without regard to the subject of such work, and vests the copyright therein, *ab initio*, not in the artist but in the person who gave the commission! This was doubly unfortunate. Not only did it rob the artist of his promised copyright in an imaginative composition, for example, and hand it over to a man who may have only bespoken his next picture without even suggesting the subject, but it encouraged the opponents of the Bill to insist that the artist's copyright, in the case of a sale of completed work, should be dependent for its very existence on a written agreement signed by the purchaser at or before the sale of the picture. Now as most purchases are made from the walls of an exhibition, the copyright in nine cases out of ten is thus absolutely lost, and no joint action of the vendor and purchaser can revive it. Of course a dealer or art publisher who buys for the purpose of reproduc-

tion well knows how to take care of himself; but very few private purchasers could make any use of the copyright if they had it, nor do they want it or even think about it until asked to sign a consent in writing to its reservation to the artist, when they naturally suspect they are being robbed of some valuable right. Passing by the vexatious formality of registration as a condition precedent not only to legal enforcement of right (as in the case of literary copyright), but to the right itself—so that no remedy can be obtained for the most flagrant wrong committed before registration—and passing over many minor defects and anomalies in the present state of the law affecting copyright in works of art, the above may be taken as a rough outline of the existing relations between art producer and purchaser; and may serve as a short preface to the paper to be read by Mr. Edwin Bale. And here I may say what Mr. Bale will probably be too modest to say for himself, namely, that he is an original creative artist himself, as well as the representative of large reproducers of the designs of others, and has a thorough appreciation of the wants and interests of both parties, and a practical knowledge of their relationship in the joint work of production of book and periodical illustration. One word of advice at the risk of being thought didactic! Stick to the enunciation of broad principles, and be not tempted to drift into critical discussion on details of draftsmanship. Last year's Bill was prepared by the Copyright Committee of the St. John's-wood Art Club—of which committee Mr. Bale was himself an active member. It was settled by an experienced counsel; approved with slight modification by the Royal Academy, after a report from their legal advisers, and is now in the hands of a noble lord, as competent as any living draftsman, to make the clauses adequately carry out the intention of the Bill. You can best help by expressing in clear but popular language what, in the opinion of this representative meeting the objects of the Bill should be, rather than by indicating the particular methods by which those objects should be carried into effect.

Mr. T. E. SCRUTTON said he was the unfortunate draftsman of the Bill before the House of Lords, and having had the advantage or disadvantage on two occasions of being thoroughly cross-examined upon it by the House of Commons Committee, he had found the most extraordinary number of traps lurking beneath apparently the simplest language, and how possible it was for words which he thought were perfectly clear, to be misunderstood in the most startling way by comparatively intelligent people. He felt, therefore, rather diffident in speaking about it, and it had been said that the worst possible person to interpret an Act was the person who drafted it; he, therefore, quite agreed with Mr. Basil Field that any discussion should deal not with details but with the principles it endeavoured to carry out. Those principles were laid down for him by the committee, and were first that the Bill should include every work of genuine art, making a broad distinction butween original works of the higher arts, and those which involved in the main mere reproduction, so that the author of a painting, an original statue, or an original engraving, should have higher rights and a longer term than the man who merely used a kodak, and went through the mechanical operation of copying, with the aid of light, some pleasing scenery. The second principle was that the present absurd chaos with regard to commission works should be swept away. At present, if he went to the Chairman, caught in a thoughtless moment, and bought a picture of him without anything being said about copyright, Sir Lawrence Tadema would have no copyright, nor he either, because nothing had been signed by one or the other, either reserving it to the artist, or transferring it to the purchaser, and so the copyright was lost entirely. This apppeared to be the result of a series of amendments in Parliament, no doubt for the purpose of ensuring that if members of Parliament had portraits of any of their families painted they should not be reproduced without their consent. The principle of the new Bill was that the copyright should remain with the artist, unless something in writing took it away from him; but with this protection to the purchaser, that the artist could not reproduce it without the purchaser's consent. In that way the artist retained control and would be spared the pain of seeing his work used as an advertisement of somebody's soap; he would be able to control the forms of reproduction, but would not be able to circulate against the wish of the purchaser reproductions so like the original that two purchasers might stand and discuss which was the original and which the copy. The great difficulty with the Bill was that the tribunal which would settle the Bill were not artists, but gentlemen who had portraits painted and who approached the subject from that point of view. Artists were unanimous as to the desirability of some such provision, but Parliament was a tribunal which would probably take the opposite view, and he had no doubt that the most serious difficulty would be with the clause relating to commission works. Another important principle involved was that affecting registration. The present system was a ridiculous sham; it did not really enable the public to know whether a work was copyright or not. After looking at the volumes at Stationers' Hall and finding no entry, a firm might issue an elaborate book at great expense with reproductions, and next day find themselves stopped by an injunction. The system was extremely technical, and when he had the honour of appearing for pirates, as he sometimes did, the first thing was to see if any fault could be found with the registration, and very frequently it could. An elaborately technical system lent itself to ingenious pirates. Another difficulty was the absurd complexity of the various Acts. Under the Art Act

you must register before the infringement complained of or you could not sue; in the case of a book you could register the day before the issue of the writ. If registration was intended to protect the public, it did not do so; and if it was intended to protect the artist, it failed, on account of the technicalities. You might sweep away registration altogether, and say that any one who copied a picture did so at his own risk; that would not hurt the artist, but it might hurt the enterprising gentleman who stood between him and the public—the publisher, who generally knew his way about Stationers' Hall, and it might hurt the public more than the present system, as it would make it more difficult to know whether they were getting a copyright picture. The other system would be to make registration effective by making it compulsory, and that the Bill proposed. The public would then know, by inspecting the register, whether a work was copyright or not, unless it remained still in the hands of the original artist, of whom they could then inquire. The Bill had roused a great outcry from photographers, who asked why they should be required to register every photograph they took; why could they not wait until somebody copied it. He had not much sympathy with the photographers on this matter, because they were getting far more protection than was accorded them in any other country in Europe, where the term was generally five years, and in some they had to show that the photograph was an artistic production, which would cut out a great many altogether. This Bill proposed to give them thirty years, and for that extension, and for the money they might get from the illustrated papers in consequence, he did not think they could complain of having to tell the public that they claimed the copyright. The other matter in which the Bill made an advance was that it rendered it more easy to stop infringement. Some gentlemen present knew how difficult it was to stop piracy. There were three well-known firms in Jersey, where the Art Copyright Act was not in force, which made photographs of any number of copyright pictures, which they sent to England through the post. He had seen an admirable series of photographs of the Chairman's works. The Post-office would not stop them unless you gave information—which you could not do—what packets contained copyright infringements; and it was the same with the Customs; they required to have a copy of the original supplied to them, and also information as to what packages to search. The result was that, both by post and through the Customs, large quantities of these piracies were sent to England. The people who imported them were known, but there was no power to search or seize, until they began to sell. Of course, they did not open a shop; they got a gentleman of no particular occupation, name, character, or residence, and sent him about the country with a basket containing other wares, and he called at city offices, and at the backdoors of houses, and sold these pictures one by one at about a tenth of the price at which they could be legitimately obtained. If, by chance, you caught him selling a copy you could issue a writ, and you might be able to serve it on him, and then in the course of a few months you would get an injunction to stop him; but where would he be then? He would be miles away, and would probably have transferred his stock to another gentleman of equal substance, against whom you had to begin *de novo*. This trade, which was followed both with regard to art and music, it was impossible to stop without an enormous expenditure of time and money. The present Bill endeavoured to meet that by giving power to stipendary magistrates to grant a search warrant, and to police constables armed with such a warrant to seize piratical stock-in-trade. From his practical experience he believed these simple expedients would be found very effective. Those were the main features of the Bill, and he predicted for it rather a stormy life, both in Committee and in the House. The photographers were up in arms against it, the process engravers had a good deal to say, and the only people perfectly satisfied with it, as far as he knew, were the Royal Academy, and the painters and sculptors. It had to go before a tribunal of country gentlemen who had their portraits painted, and he feared it would be difficult to get it, in its present form, through such a tribunal. It had been very carefully considered, and he could only hope that it would pass without alteration. However altered, it conld not be worse than the present system, and he sincerely trusted that when it became the law of the land, it would confer great benefits on artists, and justify the labours of the Committee, in preparing it, and the Royal Academy in promoting it.

Mr. FRANK BISHOP desired to say a few words on behalf of photographers, who he considered had not been treated fairly in this matter, the Bill having been settled without consultation with them at all From a commercial point of view, photography was probably more important than painting; but a few artists met and drafted a Bill without taking the opinion of photographers about it. He also objected to a photographer being compelled to register every work within six months, or lose the copyright, whilst the artist was not. This was unjust, and would be a tremendous tax on photographers. What was copyright? It was rather a puzzle; but after reading the article upon it in the "Encyclopædia Britannica," he had a clear idea in his own mind that copyright was property, and demanded the protection of the law. The law gave protection against robbery, whether of a penny or £1,000. It was quite true a photograph was not a painting by Millais; but photographers would do all they could to assist artists if they were asked, although they expected some consideration in return. They were not so powerless that they could not protect themselves, and he thought the painters would find out in time that they had made a great mistake. If copyright was property, why need you register?

Registration was only needed to mark an act of transfer of property. Ever since 1862, photographs had been claimed as fine art—he would not discuss what was art and what was not—that was the classification then adopted, and why should it be altered? Was photography of any less importance now, or were its productions any less perfect? On the contrary, it had made great strides, and many painters, if they were sincere, would acknowledge they owed much to photography.

Mr. ALFRED EAST, A.R.A., said he was under the impression that photographers had been duly considered. He had great sympathy with artistic photography, and the artistic photographer had the sympathy of every artist. He could not see the point of Mr. Bishop's observations when he said that their claims were not considered. In no country in Europe had they such privileges as under this Bill; 30 years copyright for a photograph was surely an equivalent for the protection given to the creative work of the artist; in fact, he should be inclined to say it had an undue advantage, in the light of the protection given in France and elsewhere. The point of Mr. Bishop's complaint was that they were not consulted in the drafting of the Bill, but surely that was a very minor matter; if he was willing to accept the benefits, he need not mind the method by which they were conferred. Many inquiries were made of eminent photographers, and he understood they were satisfied with the time suggested in the Bill. Photography was, in fact, introduced into the Bill as an afterthought. He should be the last to deny the right of photography to protection, or that many photographers produced works which were on a much higher artistic level than ordinary commercial photography, but protection for thirty years for a thing which cost the producer so little, comparatively, to a fine work of art, which was the result of many years of special training and special capability, seemed to him ample. He must protest against the notion that the artist photographer had not been duly considered.

Mr. J. J. ELLIOTT said he had listened with interest to the pathetic description given by Mr. Scrutton of the difficulties of the would-be pirate, whether proprietor of a journal or not, who wished to make use of the brains and money spent in producing a good photograph, in ascertaining whether it was copyright or not, and he should like to ask Mr. Scrutton or Mr. Bale why the so-called artist, because he painted half-a-dozen pictures in a year, should be exempted from registering, when the poor photographer, who produced thousands, was compelled to register.

Mr. WALTER FIELD said he had always taken the greatest interest in this subject and had done so ever since his father, who started the original Bill before 1862, used to come to Hampstead to talk about it. He recollected the question being raised of artists signing their pictures, which Mr. J. R. Herbert, R.A., thought very important. A great many artists signed their pictures but some did not, Sir E. Landseer for example. It might be a question whether there should be any provision in the Bill making it more criminal to imitate a signed work than one without a signature. There was no doubt the Bill fell in with the artist's view. He would not discuss the question whether a machine was a work of art, but artists objected to a machine view of nature. If a number of photographers took a scene they all did the same thing, but a hundred artists set opposite the same subject would make a hundred distinct pictures. Art was quite distinct from photography, and he did not know why the latter came into the Bill at all; he should have thought it would have had a separate Bill. Mr. Bale said this was merely a matter of business, but he thought it was a great deal more than that; because if an artist retained his copyright, he always had the control of the reproduction. If this had been the case hitherto, they might have been spared a good deal of the degradation of art to sordid purposes, and its production in unworthy forms. This would all be done under artistic supervision, as was the case with the engravings after Turner. It was a question, therefore, which affected not artists alone, but the whole nation.

Mr. JOHN LEIGHTON said he was one of the members of the old Copyright Committee that sat in that room for two years, under the presidency of Sir Charles Eastlake, and of the deputation to Lord Palmerston introduced by Sir Edward Landseer. They all agreed on a draft Bill, but when it emerged as an Act, they hardly knew it. The photographer was not in the original draft, but was introduced afterwards. He did not think a snapshot ought to be classed in the same category as a picture that might have taken years to paint. Members of Parliament, as a rule, knew little or nothing about the subject, which was a great misfortune. It would be well, if possible, to have the Act so simple that an international copyright might arise out of it.

Mr. SNOWDEN WARD said he was sorry to hear an artist so sympathetic to photographers as Mr. East, misrepresent the speech of Mr. Bishop. The complaint that photographers were not consulted, was a very minor point, their real grievance was one of vital principle. At present the law was that the creator of a work of art had an inherent copyright in it, and what photographers objected to was the suggestion in the new Bill that copyright was to be dependent on the creation of a work of art, plus registration, within six months of its production. He would not go into details, or he might point out what practical difficulties would result in many cases. Mr. Scrutton said there were only two alternatives—no registration or compulsory registration. Mr. Bale,

however, was not of that opinion, because he said there might be a third course, which was adopted in Continental countries. Photographers felt that inherent copyright was a thing which ought not to be attached or taken away, and the statement that there were only two ways of dealing with it seemed not quite correct in view of Continental experience.

The CHAIRMAN said the Committee, which set about drafting this Bill, started with painting, but found that photography was so intimately connected with art that it had to be included; they sent a copy of the Bill to the photographic societies with the request that they would be good enough to express their assent or dissent. He did not think they received an answer from any of those societies. He could not enter further into the discussion of how far photography was a fine art, or how far artists thought it might be lightly treated. Mr. Bishop had put it on the right ground, viz., that it was of much greater commercial importance than painting; and he did not think it was right to claim for work of such great commercial importance the same rules and laws as art, which had really very little commercial capacity. A good deal had been said in favour of the Bill, and a good deal against it, but he was sure all would agree in passing a cordial vote of thanks to Mr. Bale for his paper.

Mr. BISHOP said when Mr. Storey brought the Bill before the Royal Photographic Society, it was in print, and when asked if it would be altered if they made any suggestions he said no. He was therefore practically right in saying that the painter did not consult the photographers.

Mr. STOREY said he did not remember saying the Bill could not be altered; at that time it was merely tentative.

Mr. BALE said he had purposely refrained from introducing any question as to the relation between photography and fine art; which was one of those endless questions which could never be settled. The photographer said one thing and the artist another, but still he found that some of the best exponents of photography, such as Dr. Emerson, said that photographing was not fine art, it was photography, and never could be anything else. An artist could do a great deal in the way of arranging a picture, and so on, but that was only preparatory, when you came to take the photograph, it was photography and nothing else. An artist might be a photographer and a photographer might be an artist, but the two things could never be mixed up. One was science and the other was art. Some photographers thought this Bill was an attack on them, but he had tried to make it clear that the object was to remedy the inconsistency at present existing, and which put the artist at a disadvantage compared to the photographer. The artist had scarcely any privileges at all, while the photographer had everything. His copyright was never questioned. Mr. Elliott asked why the artist should keep his copyright without registration when the photographer was called upon to register. The Bill divided art into two classes—original art and reproductive art, including photography. It assigned two terms—life and thirty years to the artist, thirty years to the reproduction artist and the photographs—because, as shown in the paper, the position of the artist was so different, and this, bear in mind, is the recommendation of the Royal Commission. It was absolutely necessary if you gave the photographer a fixed term, that he should register, because you must give the public the information. Mr. Ward thought there was a difference of opinion between Mr. Scrutton and himself with respect to the need for registration; but that was a mistake. He had pointed to another system, adopted in other countries, which was simply a substitute for registration, and answered the same purpose. It was recognised everywhere that it was absolutely necessary the public should know when a copyright terminated. It was not fair to punish a man for infringing a copyright, without letting him know when the period began and ended. The information was given in the case of the artist under the Bill, because if there were no registration, a person wishing to copy could go to the artist and inquire; the photograph, dating from a particular time, must be entered somewhere.

Mr. ELLIOTT said photographers were considered 36 years ago to be entitled to the same protection as artists, and he could not see why after all the advance photography had made, and was still making, photographers should now be put on a lower level.

Mr. BALE said it was difficult to reply to a matter of sentiment. Mr. Elliott thought the photographer was degraded as compared with the painter by this Bill, but he had tried to show that on the contrary the object was to bring the painter up to the level of the photographer. He believed thirty years was long enough protection for a photograph, but the two terms were arranged to meet the requirements of the two kinds of work involved in fine art, and in photography and the reproductive arts.

Miscellaneous.

*THE FUNCTIONS OF THE ENGINEER.**

The success of the modern engineer is due to the fact that he has buried in the depths of oblivion the much-vaunted empirical rule of thumb, and that he has elevated to the heights of science the observations of exact practice and the exercise of pure reason.

* Abstract of Address by Sir William Henry Preece, K.C.B., F.R.S., Past-President Inst.C.E., delivered before the Glasgow Association of Civil Engineers on February 8.

The principle of doubt, which is the root of all scientific inquiry, forces him to consider every phase of weakness in the materials that he employs in his structures, to examine every possible cause of error in his designs, to anticipate every source of failure in his work. The principle of faith, which is the outcome of the growth of his experience, must be continually illuminated by the light of progress, and controlled by the patient development and consideration of the too long-hidden laws of Nature. The engineer must maintain his acquaintance with ever-growing science so as to be able to fulfil promptly and accurately his duty, which is the application of the great principle of energy and the utilisation of the marvellous properties of matter to the wants, comfort, and happiness of man.

In considering the functions of the engineer we have to consider his *practice* and his *making*.

His practice—what has he got to do? The practice of engineering can be divided into three branches—civil, military, and naval.

The term civil was originally introduced to distinguish the practical man of peace from the practical man of war. Engineering applied to our wants and comforts is a very different thing to that applied to the destruction of our foes, or to protect ourselves from their wish to destroy us. War is waged both on land and sea, and as the conditions involved in attack and defence in modern times have become so totally different in these two cases, the term military has been gradually confined to the operations of our army on land, while the term naval is applicable to the warlike operations of our fleets. England owes her present position as the centre of a great empire to her naval supremacy, and she has acquired this supremacy as much by the inventive, constructive, and maintaining powers of her working engineers as by the mighty deeds of her fearless fighting sailors.

Civil engineering aids us not only to build that haven of rest and comfort that we call "Home," but to surround it with the elements of health—pure air, pure water, pure food, pure light. If we aggregate together in towns or scatter ourselves in country districts it supplies us with all possible means of transport by road, river, and rail, and of means of intercommunication by post, telegraph, and telephone. These means of annihilating time and space are not only inter-urban in our own country, but international in our continents, and, in a wider sense, imperial, cosmical, and universal over the whole earth. The world is knit in one connected whole by wire. We know to-day from that triumph of art, science, and culture—the intelligent and free British daily public press—the history of nearly all that took place yesterday over the whole globe.

The engineer fears not the infinitely great, for the stars in their courses aid him to survey the land and to cross the deep with safety. He spurns not the infinitely little, for the molecules in their mutual actions and reactions supply him with those metals and those elements of purity and strength which give him the means to resist the forces of Nature so as to span the broad channel, laugh at the foaming river, build the palace of glass at Sydenham, cover acres of ground so as to display this year in Paris the goods, manufactures, and works of art, industry, and utility of the whole world.

The engineer utilises matter wherever it can be found; he delves into the crust of the earth for ores and minerals which give him wealth, currency, protection and strength; he dives into the sea to survey the bottom as a bed for his cables, and to see that he has secured proper foundations for his moles, piers and breakwaters; he explores the surface of the earth for articles of necessity, of use, and of luxury. He irrigates the land, to prepare it for the growth of pure and wholesome food, for the supply of cheering and sustaining drinks, for the maintenance of the stores on the shelves of the doctor, and for those articles of pure clothing that add so much to the comfort, cleanliness, and health of man. He utilises for his purposes the great principle of energy so as to transform it at his will into its various forms of heat, light, electricity, sound, and material motion. By these agencies, he transforms crude matter into its various elements, compounds, and states, so as to secure permanence, strength, and value.

Life is not free from his grasp. He has developed the Empire of Bacteria, and has encouraged the minute microbe in countless armies—to liquefy and purify our sewage, and to become the scavenger of our homes and our cities. He has, by defensive measures, freed the soil and the river from those ruthless bacterial enemies who invade our frames, and bring disease and death in their train.

Engineering is divided into various sections, many of them having their own institutions and their own publications.

The definition of a Civil Engineer, as given in the charter of the Institution, is very comprehensive.

[Sir William Preece arranged a table with the various branches of the profession set out and shown to be descended "from the one root, Engineering, which is Applied Science."]

The growth of invention in early ages was very slow. Man sheltered himself in caves. How long did it take him to devise a tent, or a hut, or a house? How long to protect himself with clothing? How long to construct weapons of offence and defence, not only to protect himself from wild beasts and from his neighbours, but to secure for himself food and raiment. The first protection from weather was probably the skins of the animals he hunted, killed, and ate, and the first art acquired—the making of leather. How long did it take him to obtain a knowledge of the use of fire, and of the means of producing it artificially, so as to cook his food, and to bake the plastic clay into pots and pans for drinking and eating purposes?

The rapid progress of modern engineering is phenomenal. Practice grows by leaps and bounds. Take any form of energy, and examine its utilisation

in any field or industry. Take only one instance of the application of electricity. See how it comes to the aid of the sailor! It controls the rudder, it ventilates the interior and the living space of the ship, it forces the draught, and assists the raising of steam, it revolves the turrets, it trains and controls the guns, it handles the ammunition, it purifies the drinking water, it lights up the ship internally, it enables the captain to sweep the horizon with the brilliant rays of the search-light, and to communicate with his tender, or with his commanding officer across space independent of weather, night, season, fog, or rain. It would lengthen this address too much to illustrate this point further. Light, sound, heat, and mechanics have been equally active in the service of man, and have helped to specialise in many directions the functions of the engineer.

General Notes.

T'UNG OIL IN CHINA.—T'ung oil is extracted rom the seed of the paint tree (*Dryandra cordasa*), which, according to the United States Consul at Shanghai, is extensively cultivated in the Yangtze Valley, also in Chekiang Province. The seeds of the paint tree are poisonous, and the oil is used occasionally for poisoning rats, also to produce vomiting in would-be opium suicides, though for the latter purpose it is neither so safe nor so effective as zinc sulphate or the stomach pump. The chief use of t'ung oil is as a standard paint, and as such it is in great demand by the natives. When boiled it makes one of the best drying oils; it is also extensively used in varnishing with the famous Ningpo varnish "t'si," *i.e.*, the dried sap of the varnish tree *Rhus vernicifera*), a good coating of which will stand considerable heat without leaving a mark, and will last for years. The various shades for colouring are produced by animal, vegetable, and mineral substances. Pigs' blood is the favourite for a first coating in varnishing. To give body and lustre to paint they mix with the oil finely powdered galena and other ores.

THE MANUFACTURE OF BATTIK.—The United States Consul at Amsterdam says that battik is made in the Dutch East Indies by the natives, who decorate their clothing with it. A piece of linen is taken and all kinds of designs are outlined upon it with a pencil. When the design is completed, the ornamented parts of the fabric are covered with a liquid which possesses the quality of stiffening after being applied. The parts not ornamented are dyed the colour desired. After the entire fabric has been ornamented in this manner, it is boiled in hot water so as to take the hard stuff out of the battik. The dyed parts will then hold the dye, and the battik is ready. People at the Hague were the first to introduce battik into Europe. It is made on linen, silk, velvet, and leather, and is exported to all the principal cities of Europe. Orders have been received from the Government to decorate the Netherlands department of the Paris Exhibition in battik.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

FEB. 28.—"Pneumatic Despatch." By PROFESSOR CHARLES A. CARUS-WILSON, M.A. SIR FREDERICK BRAMWELL, Bart., D.C.L., F.R.S., will preside.

MARCH 7.—"Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources." By DR. CARL PETERS.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S. The RIGHT HON. SIR WILLIAM HART DYKE, M.P., will preside.

MARCH 21.—"The Use and Abuse of Food Preservatives." By DR. SAMUEL RIDEAL.

Dates to be hereafter announced:—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Orloff Process of Colour Printing." By W. H. WARD.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

[The meetings of February 8, and May 17 will be held at the Imperial Institute.]

Foreign and Colonial Section.

At 4.30 o'clock :—

February 27 (Tuesday).—"Agricultural Education in Greater Britain." By R. Hedger Wallace.

Sir Edward Sassoon's paper, "Imperial Telegraphic Communication," announced for Tuesday, March 20, is unavoidably postponed.

April 2 (Monday). — "The Century in our Colonies." By the Right Hon. Sir Charles Wentworth Dilke, Bart., M.P. The Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., LL.D., will preside.

Applied Art Section.

Tuesday evenings at 8 o'clock :—

March 13.—"English Furniture." By Lasenby Liberty.

April 3. — "Process Engraving." By Carl Hentschel. William Luson Thomas will preside.

April 24.—"The Practice of Lettering." By Edward F. Strange. Sir William Abney, K.C.B.. F.R.S., will preside.

Cantor Lectures.

Monday evenings at 8 o'clock :—

E. Sanger Shepherd, "Photography of Colour." Four Lectures.
March 5, 12, 19, 26.

Professor James A. Fleming, D.Sc., F.R.S., "Electric Oscillations and Electric Waves." Three Lectures.
May 7, 14, 21.

MEETINGS FOR THE ENSUING WEEK.

Monday, Feb. 26...Sanitary Institute, 74a, Margaret-street, W., 8 p.m. Dr. J. Priestley, "Ventilation, Warming, and Lighting."
Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. R. Hedger Wallace, "Colonial Agriculture."
Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. Scoble's paper, "The Bacterial Treatment of Sewage."
Actuaries, Staples-inn Hall, Holborn, 5½ p.m.
Camera Club, Charing-cross-road, W.C., 8¼ p.m.
Medical, 11, Chandos-street, W , 8 p.m.
London Institution, Finsbury-circus, E.C., 5 p.m. Prof. G. A. Cole, "The Heart of Europe."

Tuesday, Feb. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Foreign and Colonial Section.) Mr. R. Hedger Wallace, "Agricultural Education in Greater Britain."
Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. Ray Lankester, "The Structure and Classification of Fishes." (Lecture VII.)
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. John Dewrance, "Corrosion of Marine Boilers."
Photographic, 66, Russell-square, W.C., 8 p.m. Mr. W. Friese-Green, "Electricity in Connection with Photographic Action."
Childhood Society, 72, Margaret-street, W., 8 p.m. Dr. F. Warner, "The Elements of Early Training."

Wednesday, Feb. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. Carus-Wilson, "Pneumatic Dispatch."
Sanitary Inst., 74a, Margaret-street, W., 8 p.m. Dr. Thresh, "Water Supply and Pollution."
Royal Society of Literature, 20, Hanover-square, W., 1 p.m.
Patent Agents, 19, Southampton-buildings, W.C., 7½ p.m. 1. Discussion on Mr. J. Imray's paper "Subject Matter of a Patent." 2. "Papers and Communications on Compulsory Working."
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Thursday, March 1.. Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Linnean, Burlington-house, W., 8 p.m. 1. Mr. C. B. Clarke, "Botanic Nomenclature." 2. Mr. F. Chapman, "Some Foraminifera of Tithonianage from the Limestone of Nesseldorf."
London Institution, Finsbury-circus, E.C., 6 p.m. Prof Silvanus Thomson, "Electric Locomotion."
Royal Institution, Albemarle-street, W., 3 p.m. Dr. C. Waldstein, "Recent Excavations at the Argive Heræum." (Lecture I.)
Camera Club, Charing-cross-road, W.C., 8¼ p.m.
Chemical, Burlington-house, W., 8 p.m. 1. Mr. H. A. D. Jowett, "Pilocarpine and the Alkaloids of Jaborandi Leaves." 2. Mr. F. S. Kipping, "Isomeric, partially Racemic, Salts containing Pentavalent Nitrogen," Parts I.-VII. 3. Messrs. F. S. Kipping and Harold Hall, "New Synthesis of Indene." 4. Messrs. E. Divers and T. Haga, "Potassium Nitrito-hydroximidosulphates and the non-existence of Dihydroxylamine Derivatives." 5. Messrs. E. Divers and T. Haga, "Identification and Constitution of Fremy's 'Sulphazotised Salts of Potassium.'" 6. Messrs. A. Lapworth and E. M. Chapman, "Some Acids obtained from α-dibromocamphor."

Friday, March 2...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting. 9 p.m. Major Ronald Ross, "Malaria and Mosquitos."
Sanitary Inst., 74a, Margaret-street, W., 8 p.m. Mr. H. D. S. Wood, "Building Materials."
Geologists' Association, University College, W.C., 8 p.m.
Junior Engineers, Westminster Palace-hotel, S.W., 8 p.m. Mr. W. Paddon, "Electrolytic Zinc as a Protective Metallic Coating for Iron and Steel."
Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.
Physical (in the Physical Laboratory of University College, Gower street, W.C), 5 p.m. 1. Dr. F. G. Donnan, "The Relative Rates of Effusion of Argon, Helium, and some other Gases." 2. Mr. E. C. C. Baly, "The Distillation of Liquid Air and the Composition of the Gaseous and Liquid Phases." 3. Mr. T. S. Moore, "The Reversibility of Galvanic Cells." 4. Mr. M. Solomon, "The Damping of Galvanometer Needles."

Saturday, March 3..Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Polarized Light."

Journal of the Society of Arts,

No. 2,467. Vol. XLVIII.

FRIDAY, MARCH 2, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FOREIGN & COLONIAL SECTION.

Tuesday, February 27, 1900; Sir William Thiselton Dyer, K.C.M.G., Director Royal Gardens, Kew, in the chair.

The paper read was "Agricultural Education in Greater Britain," by R. Hedger Wallace.

The paper and report of the discussion will be published in the next number of the *Journal*.

Proceedings of the Society.

THIRTEENTH ORDINARY MEETING.

Wednesday, Feb. 28, 1900; Sir Westby B. Perceval, K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Boden, Edward Goulden, North-street, Romford, Essex.
Dick, George Handasyde, 31, Hamilton-drive, Hillhead, Glasgow.
Dunn, J., Brunswick-house, Cambridge.
Dutt, Romesh Chunder, C.I.E., 54, Parliament-street, S.W.
Glover, William, 16, Market-street, Newcastle-on-Tyne.
Tata, Jamsetjee N., Victoria-building, Fort, Bombay, India.
Wagstaff, Edward Wynter, 3, Fytche-road, Rangoon, Burma.

The following candidates were balloted for and duly elected members of the Society:—

Daniell, Frederick B., 32, Cranbourn-street, W.C.
Millington, John, Mayor of Worcester, The Hollies, Rainbow-hill, Worcester.
Povah, Charles, 18, Exchange-street, Manchester.
Summerbell-Rennie, R. L., M.A., Harleigh School, Bodmin, Cornwall.

The paper read was—

PNEUMATIC DESPATCH.

By Professor C. A. Carus-Wilson, M.A.

The question of the intercommunication of the inhabitants of London was chosen by the Chairman of this Society as the subject of his inaugural addresses at the opening of this Session and of that of 1898.

In those addresses Sir John Wolfe Barry dealt with the question of the intercommunication of the inhabitants of London by means of streets, and he pointed out the enormous loss to the community, both in public convenience and in actual money value, due to the congested state of the thoroughfares of the metropolis. He endeavoured to prove, as I believe successfully, that it would be worth while laying out many millions of pounds in order to remove the causes of congestion.

The traffic that we see in our streets is, however, but the complement of that which is passing continuously along those channels of communication by means of which intelligence is conveyed, and the whole social and commercial life of the metropolis carried on. Streets and thoroughfares have their own special functions to perform; they may be likened to the arteries of the body, while the lines along which intelligence is conveyed resemble its nerves. Congestion in either is fatal to the well-being of the whole.

The Post is by far the most important of the many means of communicating intelligence in London, and in this paper I propose to consider to what extent it might be improved by the utilisation of some recent advances in mechanical science.

A letter posted recently at the Post-office in Parliament-street and addressed to New Broad-street, a distance of two and a half miles, took two hours and forty-three minutes from the moment of posting to the moment of receipt. The letter happened to be posted just as a collection was being made. If we allow fifteen minutes for the time that generally elapses between the moment of posting and the moment of collection the time occupied would have been about three hours. I think I shall not be far wrong in taking this as a typical case for consideration, so I shall proceed to analyse the reasons why this letter took such a long time to cover so short a distance.

A letter is subject to certain delays which may be classified as follows:—Delay of accumulation, delays of handling, and delays of transit. Consider first the delays of accumu-

lation. A letter has to lie in the box several minutes before collection. Throughout the whole of its journey to its destination it is subject to the disadvantage of having to wait for other letters to accumulate before it can be sent on. The trial letter, which was posted in time for the 11.45 collection, had stamped upon it "12.15, London, S.W.," thus showing that within half-an-hour of the time of collection the letter was no nearer its destination than when it was posted. Adding together the delays due to accumulation at each stage of the journey we shall not be far wrong in saying that one hour, or one-third of the whole time of travel, is lost in waiting for other letters.

Take now the delays of handling. The letter is taken out of the collecting box and put into a bag with several other letters to await the departure of the van which takes it from the Branch-office to the District-office. There it is thrown out with other bags, which have to be arranged, and carried to the sorting and cancelling tables. When these processes have been effected the letter finds it way into another bag, which, when ready, is closed and carried down to await the departure of the mail van. It is then taken up and thrown in the mail van which takes it to the General Post Office. Here a similar process is gone through, many minutes passing, during which the bag containing the letters is lying about awaiting the next stage. All these delays, though not perhaps exceeding two or three minutes each, in the aggregate mount up to a considerable time, and I estimate that in the case I have taken, quite forty minutes would be lost in this way, which added say to twenty minutes for actual delivery brings the total up to one hour.

Now consider the delays of transit. The mail vans have to travel along the congested thoroughfares, and are subject to the delays common to the traffic of the metropolis. Forty minutes would not be too much to allow for a mail van to get from the District-office at Victoria to the General Post Office. Even then the van might be delayed by an unexpected block in the traffic at some point, thereby just missing a delivery, and adding, perhaps, twenty minutes more, making the time of transit practically one hour.

Summing up the different delays, we may roughly divide the three hours occupied by a letter in getting from Westminster to the City as follows:—Sixty minutes for accumulation, sixty minutes for handling and delivery, and sixty minutes for transit.

The foregoing analysis of the delays to which a letter is subject in passing through the post enables us to see the lines upon which a system would have to be developed so that we might send letters in as short a time as we now send telegrams. Such a system must ensure that the letter shall be despatched immediately, without waiting for other letters, thereby eliminating the delay due to accumulation. The letter must be brought right into the post-office, and deposited close to the sorting and cancelling tables, thus reducing delay due to handling; and thirdly, the letter must be transmitted rapidly from point to point by some means that is not hindered by surface traffic, thus reducing the delay of transit. All these requirements appear to be satisfied in a system of pneumatic despatch.

Stated briefly, this system consists in connecting two or more points by a tube placed underground. A written message or letter is packed inside a carrier, which closely fits the tube in which it is placed. Air pressure is then brought to bear upon the carrier, which is blown through the tube at high speed. Such a system, in theory at any rate, fulfils the required condition. The letter can be sent off immediately, thus avoiding delays of accumulation. The ends of the tube into which the carrier is put through and which it is transmitted, can be placed close to the sorting desks in any convenient part of the building, thus avoiding delays due to handling. Thirdly, the tubes themselves can be placed underground, where they are not affected by outside influences, and any desired speed of transit can be attained.

The pneumatic system was introduced into England as long ago as 1853, in order to meet a difficulty encountered by the Electric and International Telegraph Company in keeping up a communication between their branch and central stations. It was found that when a great number of telegraphic messages had to be sent, the accumulation involved great delay in transmission, and it was decided to send them by pneumatic despatch.

In the year mentioned, Mr. Latimer Clark laid down a line of tube connecting the Company's office in Telegraph-street with the Stock Exchange. This was a single line of three inches diameter, actuated by a vacuum, that is to say the air was exhausted at one end, and the carriers were blown through by pressure of the atmosphere. This was the first pneumatic despatch line used in any country.

In 1858, Mr. C. F. Varley introduced, for the

first time, the use of compressed air, thus enabling a double line of tubes to be used, the carrier passing in one direction under the action of compressed air and in the other under the action of a vacuum. Figure 1 is a section of the valve in use at this time. The carrier was inserted in the chamber M. On drawing the handle H the mouth P of the chamber was closed and air admitted behind the carrier.

In 1870, Messrs. Siemens and Halske introduced two important modifications. In the first place they proposed to use a current of air circulating through a continuous line of tube, passing out to a distant point, and returning, not necessarily by the same route,

exceed three inches in diameter and were not used for carrying letters.

In 1855, Sir Rowland Hill instituted an investigation into the possibility of carrying mails by the pneumatic system. The scheme was pronounced to be feasible, but to involve so great an expense as to necessitate an extra tariff, a course which Sir Rowland Hill did not see his way to adopt.

In 1861, an experimental line, two-thirds of a mile long, was laid down in Battersea-park by the Pneumatic Despatch Company. This tube was 2 ft. 6 in. high, nearly circular in section, and contained rails on which ran a small carrier. The air was exhausted at one end by

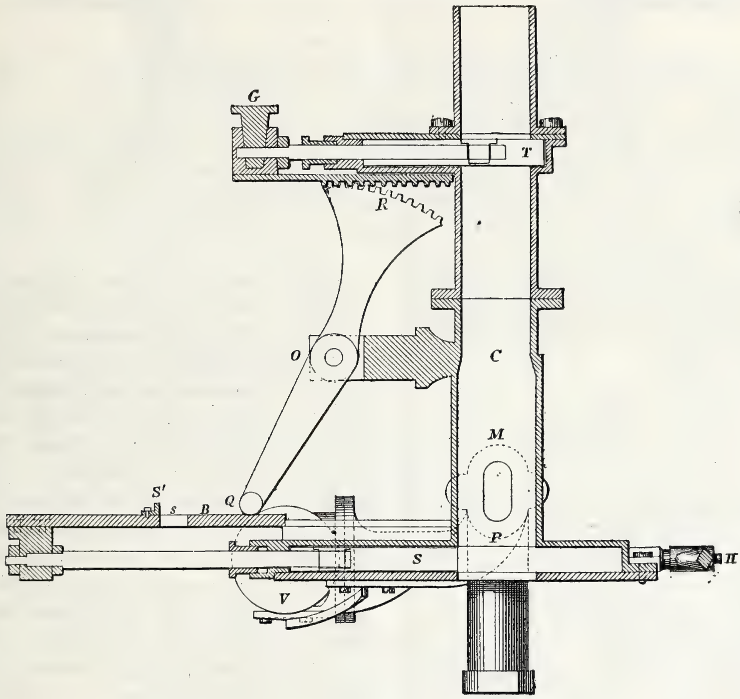

FIG. 1.

to the point of departure. Secondly, they proposed intermediate valves, by means of which a carrier could be put into the tube at any part of the circuit without interfering with the flow of air or the travel of other carriers in the tube. Figs. 2 and 3 (p. 312) are sections of Siemens's intermediate valve. The carrier was placed in the chamber A' which was then rocked into line with the tube A, a bye-pass G allowing the air to flow freely during the process.

The pneumatic system was adopted on a gradually increasing scale by the English Government for the conveyance of telegraphic despatches, but the tubes laid down did not

a large fan, and the carrier driven through by atmospheric pressure. The success of this experiment was considered to be so great that the tube was transferred and laid down between the North-Western District-office in Eversholt-street and the London and North Western Railway Station at Euston. This tube was opened for traffic in February, 1863, and for several months carried the mails between the Eversholt-street Post-office and Euston. Figure 4 (p. 313) is a sketch taken at the opening of this line which appeared in a contemporary number of the *Illustrated London News*.

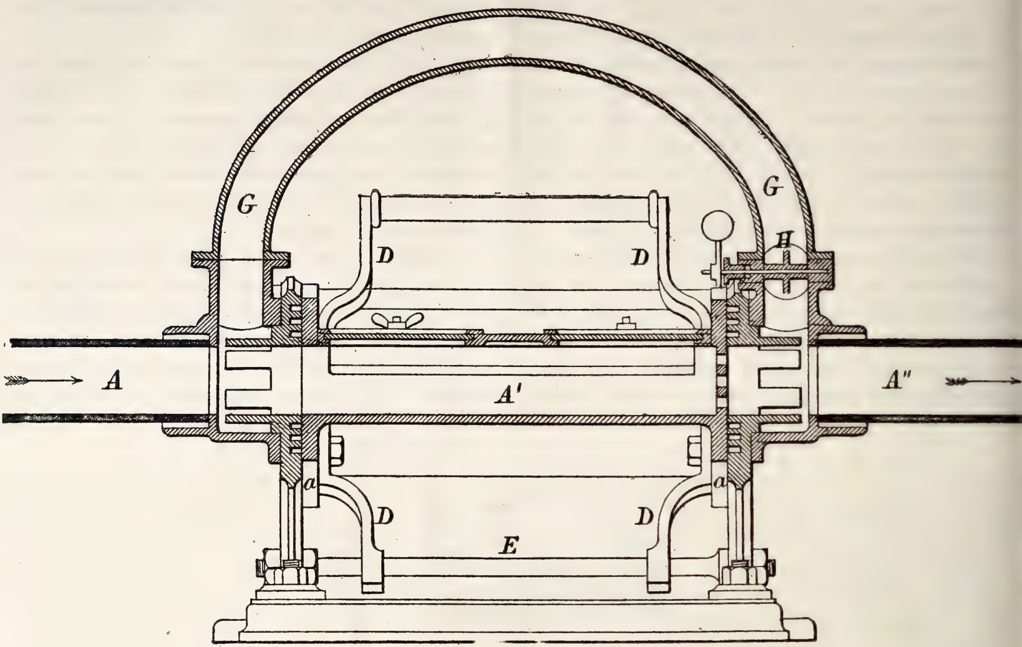

FIG. 2.

The successful working of this line involved the overcoming of a great many difficulties; notably that of bringing the carriers to rest at

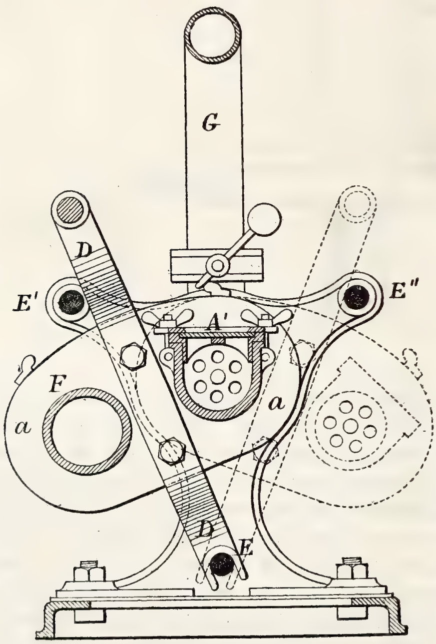

FIG. 3.

the exit of the tube. This was accomplished by the engineer to the company, Mr. T. W. Rammell, to whose ingenuity the whole of the pneumatic apparatus was due.

The Pneumatic Despatch Company was so satisfied with the results of the working of this line, that they took measures to construct a line on a much larger scale, connecting Euston Railway Station with the General Post Office. This tube was 4 ft. 6 in. wide inside, and had an area nearly three times larger than the one laid down in Eversholt-street.

The first portion of the tube was about one mile long, and connected Euston with a station in Holborn, where the engines were placed. This line was opened to the public for traffic in November, 1865. The second portion of the line, about a mile and half in length, was constructed later, and connected the station in Holborn with the General Post Office. The tube was laid underneath Oxford-street, Holborn, and Holborn-viaduct, and is still intact. Trains of cars travelled throughout the whole length of this line from the General Post Office and back, calling at the intermediate station at Holborn. Experiments showed that twelve tons of mail could be carried through from end to end in about 14 minutes. The enterprise, however, was not a commercial success, and its use was abandoned.

No further attempts seem to have been made to convey letters by pneumatic despatch until the year 1892, when a line of tubes, 6 inches in diameter, was laid down in Philadelphia, between the General Post Office and the Bourse, for the purpose of carrying mails

between these points, the system employed being that designed by Mr. B. C. Batcheller. This system makes use of a continuous and uninterrupted flow of air. Tubes connecting the different points are laid underground, and the letters are conveyed in steel carriers closely fitting inside the tubes, forced along by the action of compressed air admitted at one end.

The carriers consist of a thin steel shell, as shown in Fig. 5 (p. 314), with two bearing rings of specially prepared woven cotton fabric, which fit the tube closely. These rings have been known to run for 10,000 miles before needing replacement. The carrier is closed at one end by a hinged lid, secured by a lock, so arranged that it cannot come open when inside the tube. The figure shows carriers for 6 inch and 8 inch tubes, also those used at present in London, and the small carriers used in Berlin. The carriers are 24 inches long, and have a capacity of 800 cubic inches and a weight of 13 pounds when empty. They can hold, on an average, 600 letters.

The simplest form of pneumatic circuit is equipped as follows:—An air compressor at one end, supplying the compressed air to the tubes. An up and down line of tubes laid underground, connecting the two stations. A transmitter and a receiver at each station.

The air passes from the compressor through the transmitter along the up line of the tube to the distant receiver, through which it flows in an uninterrupted course to the transmitter in the distant station, back through the down line of tube to the receiver in the first station, and thence to a large reservoir at atmospheric pressure, from which the compressor draws its supply. The object of this arrangement is to utilise as far as possible the same air continuously, and not to draw more air from the atmosphere than is necessary to make up for leakage.

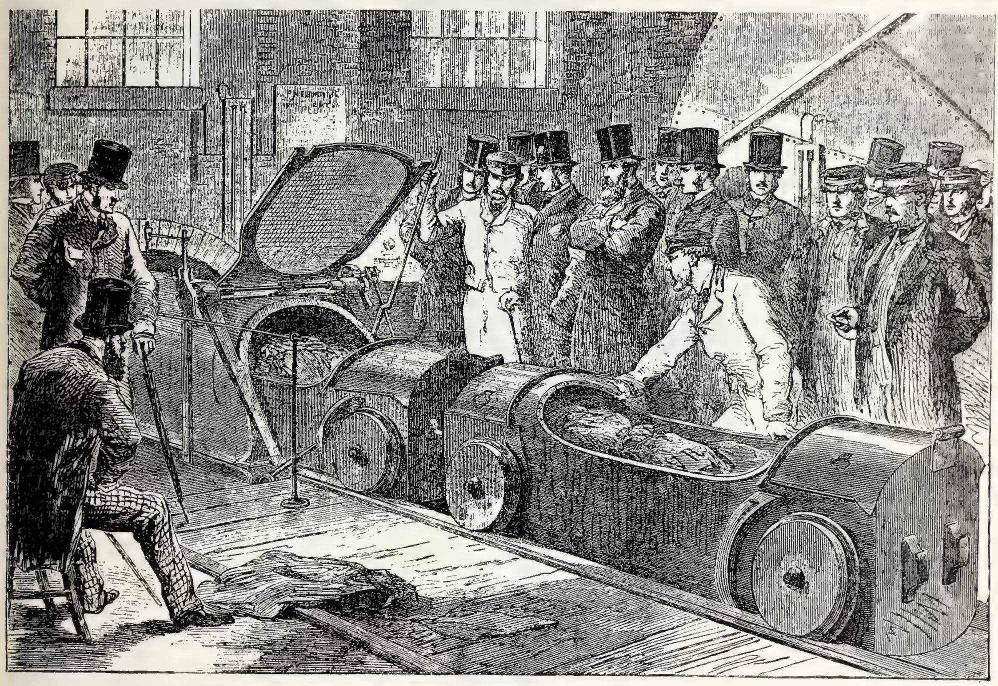

Fig. 4.

The steam compressors are of the ordinary duplex type, the compression taking place in a single stage without artificial cooling. The transmitters at both ends of the line are of the same type, and consist essentially of a rocking piece, such as M in Fig. 7 (p. 315), carrying two cylinders, B and C, which can be rocked at will into line with the tube. A bye-pass, D, is provided by which the air can flow continuously along the tube while the rocker is being moved. In the position shown in the figure, the air is passing directly through the cylinder B, and the cylinder C is accessible to the

operator. The carrier is inserted and the rocker thrown over, when the cylinder C comes in line with the tube, and is exposed to the

a *b* *c* *d*

FIG. 5.

a. Carrier used in the Berlin system.
b. Largest carrier used in the London system.
c. Six-inch carrier used in the first Philadelphia system.
d. Eight-inch carrier used in New York, Boston, and Philadelphia.

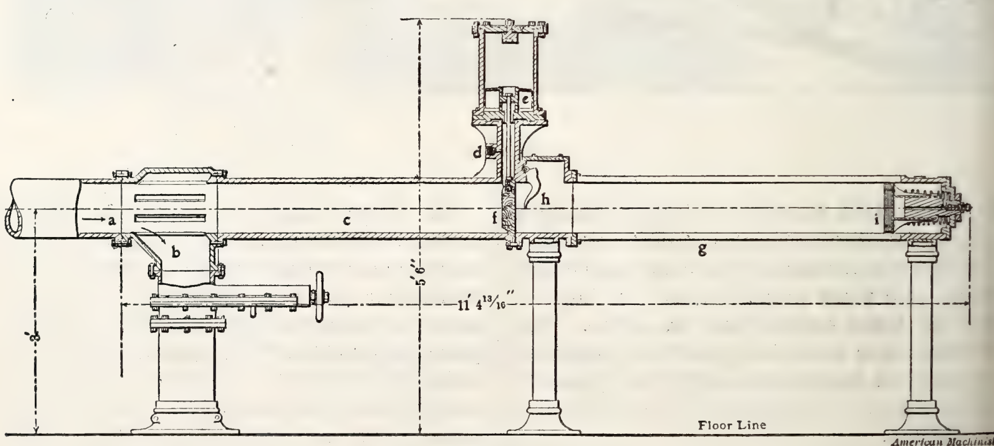

FIG. 6.

orce of the air pressure which catches it and carries it forward.

The rocking motion is effected by a pneumatic piston working in a cylinder, H. When the operator wishes to despatch a carrier, he pulls the lever K, thereby setting a spring in tension which discharges the carrier if allowed

to do so by a time-lock, which can be set for any given number of seconds, at the expiry of which time air is admitted into the cylinder H, and the rocker thrown over automatically. The object of this time-lock is to prevent the operator sending the carriers at too short intervals through the tube. The headway between the carriers is fixed say at ten or twenty seconds as the case may be, and the operator has simply to insert the carrier and pull over the lever, when the time-lock will despatch the carrier at the proper moment.

The receivers at the near and distant station differ from one another, because the pressure of air at the distant station may be several pounds per square inch, while at the return end of the tube in the near station it will be that of the atmosphere; hence a different kind of receiver is needed in order to deal with the difference in the pressures.

The receiver used at the distant station is called a closed receiver. This is furnished with a dead end, into which the carrier passes by its momentum, and where it is brought to rest by the buffing action of the air which it compresses ahead of itself. Meanwhile the stream of air continues to flow uninterruptedly through slots. The compression of the air in the dead end works a pneumatic piston, by which the dead end is turned over and the carrier allowed to fall out by its own weight on to a receiving-table.

The receiver used at the near station is called an open receiver, a section of which is shown in Fig. 6 (p. 314). The air passes continuously along the tube through the slots, and down to

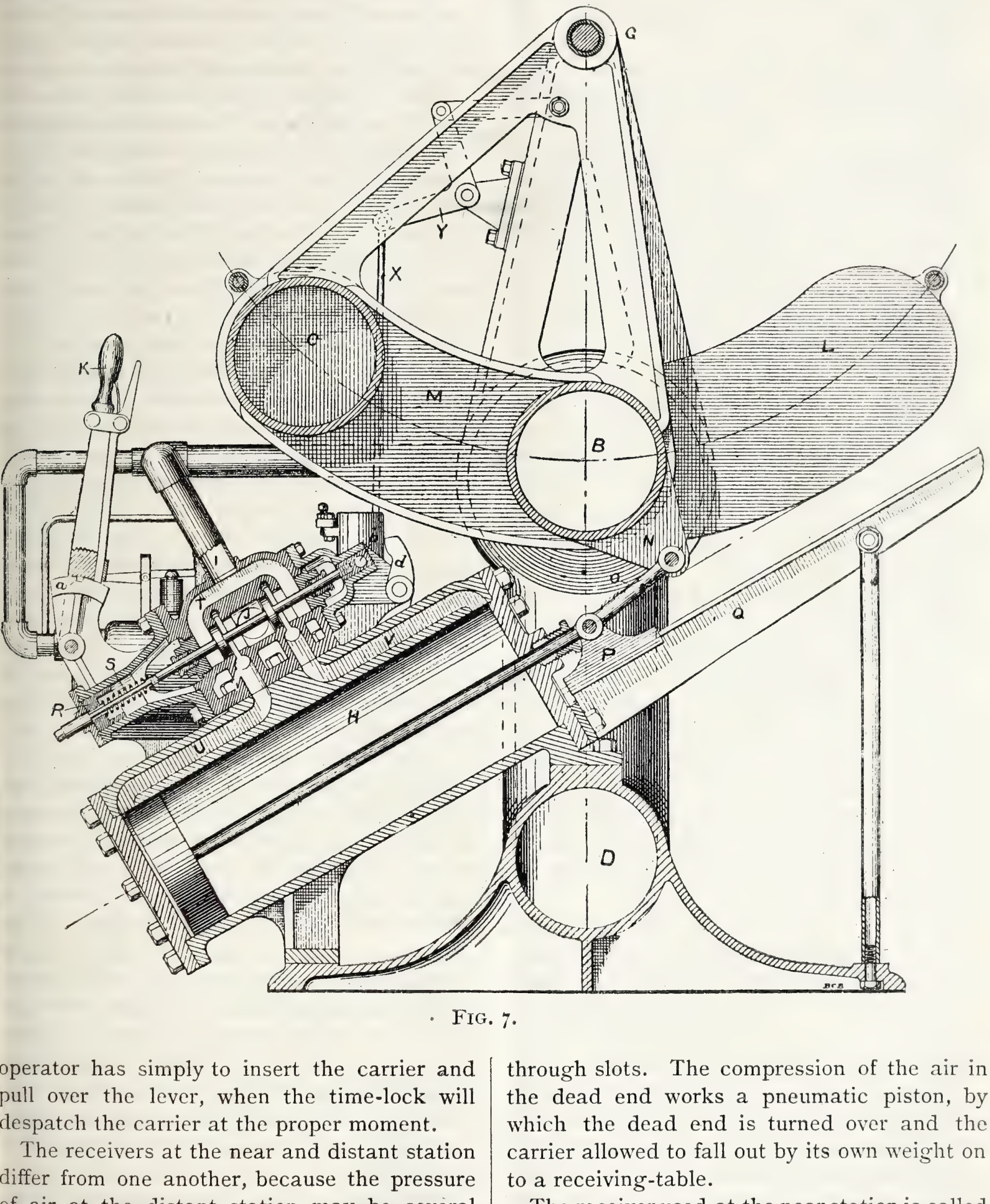

Fig. 7.

the air reservoir. The carrier is taken by its momentum into an extension of the tube beyond the slots closed at the further end by a sluice gate. It there compresses the air in front of it, and when the compression reaches a certain value it actuates a valve which withdraws the sluice gate. There is sufficient pressure of air behind the carrier to force it beyond the sluice gate out into an open receiver. The whole process acts automatically, and the carrier is brought to rest and discharged in a few seconds.

In many cases it is desirable to have a station along the line of tube, so arranged that only carriers intended for that station will be discharged there, all other carriers passing on to the distant station. In this case the intermediate station is provided with what is called an intermediate receiver, somewhat similar in action to a closed receiver. The front of the carrier is provided with a disc which is set in a particular way when the carrier is destined for the intermediate station. As the carrier comes to rest in the dead end the disc strikes an electric contact, and an electric current actuates a mechanism which rotates the dead end of the tube so that the carrier is discharged at the intermediate station, as in an ordinary closed receiver. If however the disc is not so set, the dead end will be rotated through a right angle and the carrier dropped into the main tube again and forced on its way to the distant station. The whole process is completed in about eight seconds.

Stations furnished with an intermediate receiver of this kind, are also furnished with a pneumatic switch placed in a subway in the street, at the point where the tubes diverge from the main line into the intermediate station. This street-switch is furnished with an electro-pneumatic arrangement so that the intermediate station can be permanently cut into or out of the main line of tubes.

Professor W. Cawthorne Unwin was the first to state the general principles of the motion of a carrier in a pneumatic tube, in a paper communicated to the Institution of Civil Engineers in November, 1875. He there showed that for a given initial velocity of air the pressure decreases as the distant end is approached, and that the velocity of the carrier increases with the distance from the starting point according to laws which he determined. These principles have an important bearing upon the practical working of a pneumatic tube. Thus it is necessary to know the variations of pressure along the line, since upon this depends the proper working of the different pieces of apparatus at each point. It is also important to know exactly how long it takes the carrier to travel through different portions of the tube, since the velocity is not uniform. The results observed by careful measurement in tubes now in use in the United States agree in a remarkable way with those predicted by Professor Unwin's equations.

The column of air has to be kept circulating continuously, ready to convey the carrier forward at any instant; hence by far the larger part of the work done is expended in overcoming the friction of the air on the sides of the tube. The co-efficient of friction of air in tubes of different sizes has been ascertained by numerous experiments, and is well known. If one end of the tube is open to the atmosphere, a definite pressure is required at the other end in order to move the column of air through the tube at the required velocity. Thus a mile of 6 inch tube requires a pressure at one end of 7 lbs. above the atmosphere in order to make a carrier travel through the entire length in two minutes; while an 8 inch tube, 3½ miles long, requires a pressure at one end of 12 lbs. above the atmosphere in order to force a carrier through the tube from end to end in seven minutes. The presence of a carrier in the tube tends to retard the column of air, and therefore, demands a slightly higher pressure than would be required if the carrier were absent. A carrier weighing 30 lbs. requires a pressure of about one quarter of a pound to move it at 30 miles an hour. This must therefore be added to the initial pressure required to move the column of air.

It is evident that the efficiency of such a means of transmission is exceedingly low, since only a small proportion of the total pressure required is actually used in driving the carrier. It would however be a mistake to lay undue stress upon this fact, since the criterion of efficiency in any system of despatch is the degree of usefulness obtained. For instance, the proportion of the horse-power of an express locomotive pulling a mail train that is actually expended in overcoming friction due simply to the weight of the mails, would not be regarded as an efficiency of the whole combination. The all-important condition is that the mails reach their destination as quickly as possible.

It is sometimes urged that it would be better to have a larger carrier travelling on wheels. There are three objections to this:—(1) The carrier is liable to leave the rails and get stuck

in the tubes, thereby increasing the chance of accident. (2) A heavy carrier cannot be forced up to the sorting and cancelling tables if these are anywhere but on the ground floor. (3) A large carrier running on rails introduces the practical difficulty of air leakage past the carrier. This is a serious matter, and was one of the chief difficulties encountered in the old pneumatic tube between the General Post Office and Euston.

The effect of leakage is to require a higher terminal pressure in order to make the carrier move at the same mean velocity. The larger the carrier, the more difficult it is to prevent leakage, especially when the carrier is running on wheels. In cases where it is essential to use carriers on wheels, it would be better to drive it directly by some form of motor. Thus, in the old pneumatic tube between the General Post Office and Euston, better results could have been obtained by driving the carriers direct than by the pneumatic system. Even if this were done, however, the difficulty of the air friction is not altogether surmounted, since the carrier in its forward motion has to drive before it and to drag behind it a column of air of the same length as the tube.

I had occasion recently to calculate the power required to propel, by means of electric motors, a carrier travelling in the pneumatic tube between the General Post Office and Euston. With a clearance equal to 40 per cent. of the area of the tube ; the power required to maintain the whole column of air in motion, while the carrier was moving at 40 miles an hour, was about 20 horse-power. When the speed of the carrier was increased to 60 miles an hour, the power required increased to 60 horse-power. With direct driving, an increase in the clearance involves a decrease in the power required, which is the reverse of what happens when the carrier is propelled by air pressure. Hence, when the carrier is large enough to require wheels, it should be driven direct.

Tubes working on the Batcheller system have been laid down in Philadelphia, Boston, and New York. The first to be constructed was that in Philadelphia, in 1892, where the General Post Office is connected with the branch post-office in the Bourse, distant a little over half a mile, by an up and down line of 6-inch tubes. A 30 indicated horse-power compressor is placed at the General Post Office, and the pressure required to move the air only is 7 lbs. per square inch. The time of transit is 1 minute out, and 55 seconds back. The whole of the letter mail between the Bourse and the General Post Office is carried by the pneumatic tubes, and it is estimated that letters posted at the Bourse have practically the same advantage of despatch as if they had been posted at the General Post Office.

The second line in Philadelphia, connects the General Post Office and the Pennsylvania Railway Station, with an intermediate station at the Reading Railway terminal. This is a double line of 8-inch tubes, the distance between the end stations being nearly one mile. The time of transit from the General Post Office to the Pennsylvania Station is 1 minute and 25 seconds.

In Boston, a double line of 8-inch tubes connecting the General Post Office with the Union Railway Station, distant nearly a mile, was constructed in December, 1897. A compressor of 50 indicated horse-power is placed in the basement of the General Post Office, where the average pressure is 6 lbs. per square inch. At the General Post Office, one transmitter and one open receiver are placed in the sorting-room, while at the Union Station, one transmitter and one closed receiver are employed. The time of transit from the General Post Office to the Union Station is 90 seconds. The letters are usually tied up in bundles, and thrown into the receivers. The whole of the letter mail between the Post-office and the Station is carried through the tube, and averages 361,000 letters and circulars daily. The number of carrier journeys actually made is 1,500, while the capacity of the tube would admit of as many as 10,000 being made in the day. The tube is working 21 out of every 24 hours, three hours at midnight being utilised for cleaning and overhauling the machinery. The Boston Postmaster has stated that since the opening of the tube the mails from the Union Station have been closed at the General Post Office 30 minutes later than previously, and that from 20 to 30 minutes are saved to the public in the despatch and receipt of mails from and to the General Post Office.

Three lines of tubes have been laid down in New York, each starting from the General Post Office—one extending to the Produce Exchange, laid in October, 1897 ; one to the Post Office in Brooklyn, laid in August, 1898 ; and one to the Grand Central Railway Station, laid in March, 1898.

The line to the Produce Exchange is three-quarters of a mile in length, and consists of a

double line of 8-inch tubes laid beneath the streets. The up and down tubes are worked by a single air compressor placed in the General Post Office. Each end of the line is equipped with one transmitter, the Post-office end has an open receiver, and the Produce Exchange end has a closed receiver. The carriers travel with an eight-second headway, and are running continuously from five in the morning to nine o'clock at night, the average weight of letters carried in one day being about 2,000 lbs. The time of transit is one minute and a half each way, as compared with 15 minutes formerly taken by vans. This does not represent the whole saving of time effected, since the letters are delivered close to the sorting and cancelling-tables, thereby saving the delays of handling. Further, the letters are conveyed continuously, and each letter is sent on immediately it is posted at the General Post Office.

The line to Brooklyn consists of two 8-inch tubes, and is a mile and three-quarters long. Many mechanical difficulties were encountered in laying this line, since it had to pass across the Brooklyn Bridge, and very carefully-designed expansion joints were necessary. These however have worked satisfactorily. The power plant for this line consists of one air compressor, placed in the General Post Office, and two in the Brooklyn Post Office, one of which is kept in reserve. The initial pressure is 6 lbs. per square inch with no carrier in the tube, and the carriers travel with 13 seconds headway at a mean speed of 30 miles an hour. The average weight of letters

FIG. 8.

arried during the day is 2,400 lbs., consisting f about 126,000 letters and 20,000 circulars nd papers. The whole of the letter service etween New York and Brooklyn is conducted y means of these pneumatic tubes. Fig. 9 hows the arrangements in the Brooklyn Post-ffice. The time of transit is three minutes ach way. The time with the mail vans used o be 27 minutes.

Official statistics show that there is a gain o all of the mails of about 25 minutes in the ime required between Brooklyn and New York, vhile to the mails connected with outgoing lespatches from the Grand Central Station, here is a saving of 40 minutes. This allows of a later close, which in some instances may nean a gain of many hours in delivery at listant points.

The line extending to the Grand Central Station is $3\frac{1}{2}$ miles in length, and consists of wo 8-inch tubes. There are three inter-nediate stations, one at Eighth-street, one at Madison-square, and one at Twenty-eighth-street. Air compressors for working the lines are situated at the General Post Office and at he railway station, one 90 horse-power compressor being used for each line. The initial pressure is 12 lbs., rising to 17 lbs. when the tube is being worked to its full capacity. The carriers pass through these tubes with a 15-second headway, and those destined for the intermediate stations are automatically ejected by the intermediate receivers already described. About 6,000 lbs. of letters are carried in one day, and the time of transit is seven minutes each way as compared with 40 minutes previously taken by the mail vans. The lines are worked 21 hours out of the 24.

A great feature of the traffic on this line is the supplementary service between the General Post Office and the railway-station. Special carriers are sent from thirty to forty-five minutes after closing time at the General Post Office to catch trains at the Grand Central Station, an average of two to three hundred letters being sent in this way for every outgoing mail, resulting in a saving of time to letters thus sent of from one to three hours, corresponding to the time they would have been delayed in waiting for the next mail.

I began this paper with an analysis of the

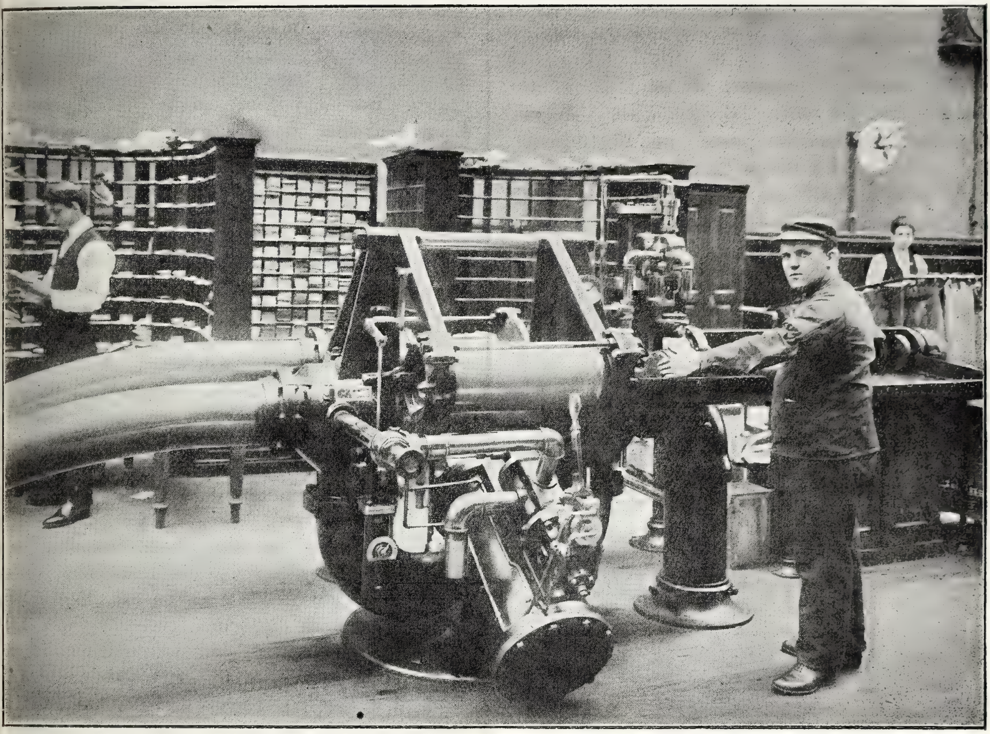

FIG. 9.

delays to which letters were subject. These delays are inevitable in a postal system conducted upon ordinary lines, however well it may be organised, and I believe that the system we have in London is not excelled by any other system of the kind anywhere. I have endeavoured to show that the pneumatic system reduces these delays to a minimum, that it is not a paper scheme, merely attractive in theory, but, on the contrary, that the working of this system in the United States has proved conclusively that it is thoroughly practical and able to bear the heaviest strains that may be put upon it.

Let us see what this system would do for us here. It would enable us to send a letter across London in one-third of the time that it takes at present. If sent on at the further end by extra delivery, with a special fee, a letter could be posted in Westminster, for instance, and reach its destination in the City within half an hour. Country mails arriving in London could be sent out at least one delivery earlier, while for out-going mails the gain would be equally marked. The posting time for the ordinary night mails could be extended from 6 certainly to 6.30, and possibly even to 7. With a late fee, letters could be posted at any of the branch offices at 7.30 instead of 7, as at present, or, with an extra fee, it would be possible to post up to 8.

Having shown that this has been done in other cities; having shown that it is most desirable to do it for this, the biggest and busiest city in the world, I can only ask, in conclusion, Why should London wait?

DISCUSSION.

Mr. Rosenbusch said one serious objection to the use of pneumatic tubes was the possibility of derangement. He knew of an instance in New York in which a carrier accidentally opened while being despatched, and blocked the tube, and before the fact was known at the central station, about 500 lbs. of mail matter were macerated in the tube. At the same time it seemed possible to make the carriers so that such accidents would not happen.

Mr. E. L. Hartley asked what arrangements were made at the intermediate receivers so that the carrier intended for one particular station might be taken out there, and the others which followed or preceded it should go on to their respective destinations.

Col. Allan Cunningham said this paper might be divided into two portions, one on the general principle of the transmission of postal matter over short distances, as to which a case seemed to be made out for much greater facility of communication by a system of continuous delivery of a small quantity at a time instead of accumulating large quantities, and then taking them through the crowded streets. The other question was as to the means by which this should be effected, because of course it might be accomplished by other means as well as by pneumatic dispatch. Could Mr. Carus-Wilson give any idea as to the advantage which this method possessed over other sources of power, such as electricity. Another question was to the effect of climate on the use of air. Would very hot or very cold weather create any inconvenience? As to the question put by the previous speaker, he should like to know how the separate carriers for the intermediate stations were known. He could quite conceive a mechanical appliance for taking out one carrier, and allowing the others to pass, but his difficulty was to see how the selection was made.

Mr. J. C. Badcock, C.B., said Mr. Carus-Wilson had taken the case of a letter going from Westminster to the City, but there might be another going to South Kensington, and another going to Islington, and how were they to be dealt with? All letters did not go to the City. If they were all to be sent to the General Post Office, they would have to turn all the warehouses out of the City, and make it all General Post Office. The number of articles now passing through the General Post Office in 24 hours was 3½ millions. So far as he understood in the United States they had several classes of mail matter—letters, which were called first-class; printed matter called second-class, and so on. In England they had no such distinction, everything was dealt with on the same basis, and the maximum size for letters was 2 feet by 1 foot by 1 foot. He need hardly say that if they got a good number of this size, as they did from the Government offices, civil engineers and so on, there would be some difficulty in getting them into an 8-inch tube. He quite admitted that the principle of pneumatic tubes, if it could be carried out, would effect a great saving in time, though not so great as Mr. Carus-Wilson anticipated. He had given 40 minutes as the time for getting from the South-Western District-office to the General Post Office, but the time allowed was 14 minutes. Again he suggested that with a late fee letters for the 8.30 mail might be received up to 8 o'clock; but they already received them with a halfpenny fee up to 7.45. He might add that Mr. Batcheller called on him a few days ago, and he gave him a plan of all the district offices in London, and was preparing information for him as to the number of letters sent by each dispatch in order to enable him to frame a proposal to be submitted to the authorities.

Mr. E. WORTHINGTON asked if the tubes were ›red, or left in their rough wrought or cast state. He ›lieved that in the small tubes used for sending ›legraphic messages the packing was made with a sort ' fluffy woollen material, which made an almost air-ght joint; but it appeared to him that the cotton ıaterial, which was described as making the pack-ıg would wear out if it rubbed for three miles every ›urney on a rough iron surface. He would ask if ıy lubricant was used.

The CHAIRMAN, in proposing a vote of thanks to 'rofessor Carus-Wilson for his very thoughtful paper, ıid he thought he had made out a case for inquiry, nd he was pleased to hear that the General Post ›ffice were giving every facility for having the ıatter investigated. The success which had ap-arently followed pneumatic despatch in the States, ertainly seemed to justify further inquiries being ıade. It was quite true that New York was ot a parallel case to London; the mass of ıatter was not nearly so great, and the area of istribution was not nearly so wide. Without in ny way seeking to criticise the scheme, he might ıy that the area of distribution in London seemed to e one of the great difficulties which would have to e overcome, because it was not one, two, three, or alf-a-dozen points, but perhaps three times that umber, which would have to be served in order ›ally to bring about any great improvement on our resent system. He thought the Post-office was ntitled to the very greatest credit for the despatch 'ith which letters were forwarded, and they could ot be expected to introduce a new system which, on ıe face of it, would be very costly, unless a very reat improvement were to be effected.

The vote of thanks having been carried unani-ıously,

Prof. CARUS-WILSON, in reply, said the remarks 'hich had been made were of just the kind which 'ere needed in opening up a question of this kind. 'here was no denying the fact that a block was ossible; all you could do was to take such precau-ons as to diminish the chance to the least possible ıinimum. He believed the block which had been ıentioned, was one out of two only which had ccurred since 1892.

Mr. ROSENBUSCH said it was the only one in 'hich mail matter had been destroyed.

Prof. CARUS-WILSON said the other block was wing to some workmen attempting to construct a ıanhole immediately over one of the tubes. With ›gard to the intermediate receivers, without going ıto minute details, he might say that each carrier ad in front of it a series of discs of different sizes, fixed concentrically, and each size corresponded to a certain intermediate station, and the way in which the disc corresponding with a particular station was exposed to the electric contact when it got into the receiver, determined whether that carrier was ejected at the station or passed on. A carrier might have three or four discs of different sizes; and if it was intended to be discharged at the third station, the disc corresponding thereto would be set in a particular way. As to the question of the power to be employed, if electricity were used, you must have a motor on the car which must run on rails, and the tube therefore would have to be much larger. Directly you got beyond a certain sized car and used rails, you threw away one of the great advantages of the pneumatic system, which was that you could bring the end of the tube right up into any part of the post-office building. Again, the cars might get off the rails, but a carrier could not get out of a tube. The great success of this system was due to the fact that Mr. Batcheller had recognised from the outset that it was absolutely necessary to bore the tubes, and make the carriers to fit them; the cotton rings fitted the tube closely, and made a good joint. No lubricant was used beyond a little moisture which might be present. With regard to the points raised by Mr. Badcock, he had taken the case of a letter going from Westminster to the City simply as an example, because if he had attempted to deal with the whole postal system of London he should never have got finished. Still, his own belief was that if nothing were done beyond putting down a tube between Westminster and the City, it would confer an enormous benefit on everybody concerned, and would pay for itself, if an extra fee were charged. The question of how such a system could be extended, so as to cope in any measure with the enormous mass of matter which was handled with such wonderful success by the Post-office, it was impossible for him to go into, or for anybody outside the Post-office, but he was sure that if there was any advantage in this system the Post-office authorities could be relied upon to make the most of it for the people of London. With respect to the late closing of the mails, he mentioned 8 o'clock because he thought he should be accused of exaggerating if he put the time later; but if it only took three minutes to get from the Post-office to Euston, there was no reason why letters should not be posted within six minutes of the departure of the train. It was certainly rather alarming to think of the thousands of packages 2 feet by 1 foot by 1 foot which poured into the Post-office, but the principle of this system was to deal with that class of communication which it was absolutely essential should be accelerated. If you had a bulky parcel of papers or plans to send, the probability was there would not be such urgent need for despatch, as in the case of a letter. This system was not intended to carry anything in the nature of freight, but simply letters, which it would pay to accelerate to the greatest possible degree.

Miscellaneous.

*THE FUNCTIONS OF THE ENGINEER.**

The Making of the Engineer.—It is idle to ignore the fact that the modern engineer is the outcome of high-class and long-sustained education, either imparted or self-acquired. Education means generally the training of the intellectual, moral, and physical faculties of youth, but the education of the engineer never ceases as long as he remains in active practice. I am still in school, and rarely fail to acquire some new fact each day of my life. The first foundation is clearly a broad, solid, general education, not specialised in any way until the pupil has reached the stage when he can think for himself. But from the very earliest years—in fact from infancy—I advocate the cultivation of the powers of observation, a systematic training of the memory, and an encouragement of the exercise of thought. This is, in reality, the scientific method. Many people advocate the early teaching of science, but I do not. I advocate the collection and naming of plants, the love of animals and knowledge of their habits, the observation and explanation of the daily occurrences in the house, the air, and the ground. The fire, a candle, the teapot, cooking, blacking boots, the dewdrop, clouds, rain, wind and storm, the ebb and flow of the tide, the performances of tops and bicycles, familiarly explained, excite a love of Nature and of Science, and train the mind to observe, to think, and to remember. Cramming the young mind with ill-digested text-book science, illustrated by experiments that generally fail, excites ridicule — the common accompaniment of ignorance.

The engineer must be a scientific man. Science deals with the facts of Nature, their laws and their theory. The engineer applies this knowledge to the uses of mankind. His practice means the correct design and due execution of works. The present President of the British Association, in his inaugural address delivered at Dover, drew no distinction between natural knowledge (science) and applied science (engineering). His illustrations to glorify the former were drawn from the triumphs of the latter. Sciences are *experimental*, such as chemistry, mechanics, and physics, and *observational*, such as botany, zoology, geology, geography, astronomy, biology, &c. They are very numerous, and, as engineering is only another term for applied science, it is clear that an engineer would waste his time in acquiring abstruse sciences that would be of no subsequent use to him. He must confine himself to those branches of science which will be of service to him in his future career, so as to enable him to apply them to living, industry, and commerce. Mathematics, the shorthand of thought and the purest form of logic, experiment, the handmaid of observation, measurement, the instigator of accuracy and precision, and reasoning, the organ of common sense, are the tools that shape his store of knowledge which memory brings to his help when he has to practice what he has learnt. The boy who has passed well through the ordinary curriculum of school, and proceeds thence into a university, from which he emerges as a young man not only well imbued with the refining influences of literature and art, but with a well-earned degree of science, is fully prepared to commence his engineering training and to enter the workshop or the drawing-office, where alone he can acquire that combination of knowledge and skill, and that training of the brain and the hand for mutual aid which is called technical education.

The Institution of Civil Engineers will now admit into their body only those who can produce the certificate of such an educational career as I have indicated above, or who can pass an examination which will give evidence of his possessing similar qualifications. A scientific man can become an engineer only when he has become an expert through practice and experience.

It is not a question between science and practice; it is a question between science and rule of thumb. Practice is always there, but rule of thumb means rule of error, until by repeated failures rule of thumb becomes rule of right, which means the victory of organised common sense. Organised common sense is a very good term for science. Scientific men talk nonsense when they observe differences between science and practice, and so-called practical men act foolishly when they ignore science, and assert that an ounce of practice is worth a ton of theory. Practice based on true science means immediate success and economy; practice based on rule of thumb means error, delay, and excess of estimates. The engineer cannot neglect the laws of nature, any more than the scientific man can ignore the success of practice. The science of the Chair has, however, often been obsolete or behind the day. The professor is not sufficiently in touch with the industrial and economical interests of the country. It happens that in my own special branch of the profession, practice has always been in advance of theory. The progress of telegraphy and telephony owes nothing to the abstract scientific man. The fundamental principles and natural facts that underlie the practice of electrical engineering are the teachings of actual experience, and not the results of laboratory research or professorial teaching. The science is, however, now established, and those who are academic students have the advantage of acquiring a knowledge of facts and principles in the class-room before they commence their practical career. Their path is thus much cleared, and their progress expedited. They start well equipped mentally to grasp and comprehend the art of their profession.

Smeaton, Watt, Telford, Stephenson, Fairbairn, Whitworth, and all our early engineers had to acquire their own natural knowledge by their own

* Abstract of Address by Sir William Henry Preece, concluded from page 367.

lividual investigations. They had to set out and termine first principles for themselves. All that is w changed. The science of to-day is the science of e Victorian era. The engineer is not now required research as much as his predecessors. There are w physical laboratories where it can be done for m, but this must not tempt him to lessen his thusiasm in verifying the facts of nature by experi- ent. Doubt must always be transformed to faith.

The civil engineer of eminence has not only to ow thoroughly the science, but to conduct the actical operations of his profession. The lives of man beings are entrusted to his designs. People ve faith in the safety of his ships, long tunnels, idges, and railway trains. He is called upon to vise on policy, to deal with commercial manage- ent, to act as arbitrator or judge in many important tricate judicial cases, and to appear in Courts of w and committee-rooms of Parliamant as an expert tness. The mental qualities of the engineer must erefore be of the very highest order. His scientific aining and his world-wide practice have broadened s views and enlarged his mind. Above all his aracter must be above all reproach. The honour the engineer is the honour of his profession. The ord Chief Justice's Bill was welcomed by every ember of the Institution of Civil Engineers. The il it is desired to suppress is very great and very ide, but it is not the characteristic of the engineer.

Let me in conclusion impress on you the antiquity d the universality of the functions of the engineer. ubal-Cain was an instructor of every artificer in ass and iron, and this before the flood. The ry earliest remains of Egyptain, Babylonian, and ssyrian temples and monuments, indicate a wonder- l knowledge of the strength of materials. The loaca Maxima of the early Latin King Tarquinius riscus exists still, though built 2,600 years ago. In e track of war and diplomacy, in the earliest days history, went trade and commerce. The general ecame the engineer. Western Asia was covered ith roads not only to facilitate the transport of oops and chariots but to assist the merchant in the stribution of his wares. Intercourse of all kinds is always been the outcome of civilisation. The lance of power falls to the strong. In days of d it was to the strong physically. In modern days is more to the strong mentally and financially. The eatest political gift that mind can give to man, the eatest security for peace and comfort, is the ability wield the great powers of nature so as to destroy man life with the greatest rapidity and at the eatest distance. An overpowering fleet and an ficient army are our insurance for security at home. here is not a habitable spot on the face of the earth at does not bear traces of the presence of the igineer. He is the great civiliser. He not only nmediately follows, but he sometimes even pre- ędes the military conqueror. He distributes peace ıd good-will without the accompaniments of fire, ood and famine. Mr. Cecil Rhodes is opening up Africa with the "wonder-working wire." Khartoum has been brought within seventy hours of Cairo by train, and ere long, when peace is restored in that self-disturbed country South Africa, Cairo and Capetown will be in direct and immediate communication by telegraph, and eventually by rail.

The engineer is not only a benefactor to his race, but he is a necessity of the age.

Correspondence.

ARTISTIC COPYRIGHT.

Mr. ALFRED EAST, A.R.A., wishes to make it clear that in his remarks in the discussion on Mr. Edwin Bale's paper on "Artistic Copyright," he stated that photography was introduced as an after-thought into the previous Copyright Bill, not, as he is reported, into the Bill now under discussion.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MARCH 7.—"Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources." By DR. CARL PETERS.

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S. The RIGHT HON. SIR WILLIAM HART DYKE, M.P., will preside.

MARCH 21.—"The Use and Abuse of Food Preservatives." By DR. SAMUEL RIDEAL.

Dates to be hereafter announced:—

"Electric Traction." CHARLES H. GADSBY.

"Steam Motors for Common Roads." By JOHN I. THORNYCROFT, F.R.S., M.Inst.C.E.

"Coal in South-Eastern England." By PROFESSOR W. BOYD DAWKINS, M.A., F.R.S.

"A National Repository of Science and Art." By PROFESSOR W. M. FLINDERS PETRIE, D.C.L.

"The Orloff Process of Colour Printing." By W. H. WARD.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

CANTOR LECTURES.

Monday evenings at 8 o'clock :—

E. SANGER SHEPHERD, "Photography of Colour." Four Lectures.

LECTURE I.—MARCH 5.

The Measurement of Light and Colour.—White light—How light waves travel—Composition of white light—The spectrum—The measurement of lights and shadows—The measurement of colour.

LECTURE II.—MARCH 12.

The Representation of a Coloured Object in a Monochrome Print. — Definition of the problem—Impossibility of representing colour contrasts in monochrome—The representation of colour according to luminosity—The preparation of a test object —Colour sensitive plates—Light filters—Progressive orthochromatism.

LECTURE III.—MARCH 19.

The Representation of a Coloured Object in its Natural Colours.—White light—Young's theory of trichromatic vision — Spectrum colours and colour mixtures—Processes based upon Young's theory—Light filters for trichromatic photography — The negative—The preparation of transparent prints in natural colours for the optical lantern.

LECTURE IV.—MARCH 26.

The Application of the Trichromatic Method of Colour Photography to the Printing Press.—Light filters—Suitable plates and negatives—Preparation of the printing surfaces—The half-tone process, its faults and difficulties—Inks—The printing of the three impressions—Colour-printing machinery.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH, 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. E. Sanger Shepherd, "Photography of Colour." (Lecture I.)

Royal Institution, Albemarle-street, W., 5 p.m. (General Monthly Meeting.)

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Mr. P. G. Smitt, "Sanitary Building Construction."

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. R. B. Grantham, "The Closing of Breaches in Sea and River Embankments."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. R. W. Allen, "The Presence of Napthalene in Coal Gas." 2. Mr. Arthur Marshall, "Notes on the Determination of the Iodine Value of Oils."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. F. Lambert, "The Crystal Caves of Yarrangobilly, N.S.W." (with crystalline effects).

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Election of Royal Gold Medallist.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. J. Zimmerman, "Coins of the Ancients."

London Institution, Finsbury-circus, E.C., 5 p.m. Rev. W. Dorling, "Oliver Wendell Holmes."

TUESDAY, MARCH 6...Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. Ray Lankester, "The Structure and Classification of Fishes." (Lecture VIII.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. John Dewrance's paper "Corrosion of Marine Boilers." 2. Sir Charles Hartley, "A Short History of the Engineering Works of the Suez Canal."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. J. A. Hodges, "Some Beauty Spots of English Scenery."

Biblical Archæology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. G. A. Boulenger, "Descriptions of new Reptiles and Batrachians from Borneo." 2. Mr. F. E. Beddard, "The Brain of the Siamang (*Hylobates syndactylus*). 3. Mr. J. Lewis Bonhote, "A Collection of Mammals from Siam."

Colonial, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Sir William Robinson, "The Bahamas."

WEDNESDAY, MARCH 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. Carl Peters, "Macombe's Country (South of the Zambesi), its Ancient Goldfields and Industrial Resources.')

Geological, Burlington-house, W., 8 p.m.

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Dr. G. Reid, "Sanitary Appliances."

Archæological Association, 32, Sackville-street, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Colonel Sir T. H. Holdich, "War Maps."

Archæological Inst., 20, Hanover-square, W., 4 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, MARCH 8.. Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8½ p.m. Prof. Warrington, "Recent Researches on Nitrification."

Society for the Encouragement of Fine Arts, 9, Conduit-street, W., 8 p.m. Mr. E. Doran Webb, "Salisbury Cathedral, and how it came to be built."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. C. Waldstein, "Recent Excavations at the Argive Heræum, in Greece." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Dr. H. Lewis Jones, "The Applications of Electricity in Medical and Surgical Practice."

Mathematical, 22, Albemarle-street, W., 8 p.m.

Camera Club, Charing-cross-road, W.C., 8½ p.m.

FRIDAY, MARCH 9...Royal Institution, Albemarle-street W., 8 p.m. Weekly Meeting. 9 p.m. Dr. F. Clowes, "Bacteria and Sewage."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Messrs. John Duncan and G. J. Day, "The Distribution of Stress in the Walls of a Thick Cylinder."

Astronomical, Burlington-house, W., 8 p.m.

Junior Engineers, Westminster Palace-hotel, S.W., 8 p.m. Conversazoine and Reception by the President, Sir Charles Parsons, and the Chairman, Mr. B. H. Joy.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, 5 p.m.

SATURDAY, MARCH 10...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Lord Rayleigh, "Polarized Light." (Lecture II.)

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FRIDAY, MARCH 9, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 5th inst., Mr. E. Sanger Shepherd delivered the first lecture of his course on "Photography of Colour."

The lectures will be published in the *Journal* during the autumn recess.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Tuesday, February 27, 1900; Sir William Thiselton-Dyer, K.C.M.G., Director Royal Gardens, Kew, in the chair.

The Chairman, in introducing Mr. Wallace, said he had very considerable experience of the subject on which he was about to speak. He had not only been in the service of the Government of Victoria and Tasmania as lecturer on agriculture, but had also been examiner on that subject in the Victorian Education Department, and had received the Hepburn medal of the Royal Scottish Society of Arts for a paper on "Agricultural Education." He was also the author of a well-known text-book on agriculture, which was in use in America, and also in the University of Aberdeen. The new faculty of agriculture in that University had so far only produced one graduate—not having been very long in existence; but it had been his (the Chairman's) good fortune to recommend that gentleman for an important position in one of the West Indian Colonies.

The paper read was—

AGRICULTURAL EDUCATION IN GREATER BRITAIN.

By R. Hedger Wallace.

There can be little doubt that the interest taken in agricultural education generally is extremely widespread. The subject I find is not discussed by a few authorities alone, but seems to appeal to and attract the attention of the general public also. The title of my paper, I trust, indicates clearly the section or branch of the subject I intend to deal with, and I would ask that it be clearly understood that I do not approach it as an authority, agricultural or educational. My paper can be best described, I think, as a compilation, in which an attempt is made to condense, in a form suitable for the general public, a large amount of data obtained from various sources. It is an attempt to answer such a common inquiry as, What are they doing in regard to agricultural education in this or that colony? I have no intention, therefore, of criticising either the work done or the methods employed in the Colonies; and I may only venture into the domain of criticism when discussing the point whether a suitable training for colonial life can be obtained in this country, or whether it is desirable to take advantage of the educational facilities in agriculture offered in the Colonies. Here, of course, all citizens looking forward to the settlement in life, either of themselves or of members of their families, meet on common ground.

The subject of agricultural education generally has within recent years been twice (as far as I am aware) brought before the Society of Arts; first by Mr. J. C. Morton, in 1887, and next by Professor Wrightson, in 1888. In Mr. Morton's paper no reference is made to the Colonies at all, while Professor Wrightson only makes a passing allusion to Canada in his. Again at the International Congress on Technical Education held in London in 1897, at the invitation of the Society of Arts, there is no detailed reference, as far as I can find, to the work done in the Colonies either in the papers read on "Agricultural Education" or in the resulting discussion. Some information, however, can be gathered from the papers on technical education. In the period under discussion, I may add, there have been quite a number of papers read and published on "Foreign Agricultural Education," but their survey has been limited to the work done on the continent of Europe or in the United States, and the Colonies have been left untouched. Yet there is one paper to which I must direct particular attention, namely, the paper by Mr. Henry F. Moore on "Agricultural and Technical Education in the Colonies" read before the Royal Colonial Institute in January, 1891. This exceedingly interesting and valuable paper in its references to work accomplished in the matter

of agricultural education in Greater Britain covers the same ground that I do in this paper. In fact I shall attempt a similar survey, but I do it after an interval of ten years, and if a comparison be made, my paper will indicate, I hope, the progress accomplished in the Colonies and dependencies surveyed.

I have already stated that the general public are interested in learning what is being done in the Colonies in regard to agricultural education, and they are also keenly interested in discussions as to whether a suitable training for a colonial life can be obtained at home or not. That such questions are really of general interest, and are not limited or restricted to the area in which dry-as-dust authorities and faddists propound and demolish the dogmatic assertions of each other, can be readily illustrated by references to our general literature as represented by the ordinary monthly magazines and reviews. I would in this connection refer to such articles as that entitled "Colonial Training for Gentlemen's Sons" in *Chambers' Journal* for 1885, to Mr. Montefiore's "Education for the Colonies" in *Macmillan's Magazine* for 1892, to the article by Frances Macnab on "The Production of Learned Pigs amongst the Poor" in *Temple Bar* for 1896, and to Mr. George J. Holyoake s article on "Emigrant Education" in the *Nineteenth Century* for 1898. The articles I have just named, and many similar ones that could be quoted, support, I think, the view that my paper should be addressed to, and primarily intended for, the ordinary man rather than for the expert. At any rate such is the position I have adopted, and I hope these prefatory remarks will sufficiently explain.

When one surveys the agriculture of Greater Britain it is at once apparent that it can be grouped under two heads, *i.e.*, farming, farms, and farmers; and planting, plantations, and planters. That there is a difference between these two groups will be at once recognised; but to define when or how the distinction is made or can be drawn is by no means an easy matter. Generally speaking, however, it may be assumed that a plantation is a large estate devoted to the rearing of tropical or semi-tropical crops—such as sugar-cane, tea, coffee, cotton, and tobacco—by the labour of an inferior or subject race. On the other hand a farm can be of any size and is cultivated by the labour of the owner, assisted when desired by the labour of men of his own race, and the crops grown are those of a temperate clime. The distinction between a farmer and planter is so marked that it has been stated (in *The Times* I think) that the tendency or tone of a body of planters is to be exclusive and aristocratic, while on the other hand that of a community of farmers is generally democratic.

The technical education or training in agriculture of a prospective farmer and a planter (I suppose this will be readily admitted), ought to differ a good deal, seeing that the work, for instance, of a tea planter in Assam differs wholly from every point of view from that of a farmer in Tasmania. As far as I am aware, however, no such distinction is made in the agricultural training obtainable in this country. Some such specialised training is, I am aware, obtainable at Kew, by gardeners, and a man going out from there to a tropical botanic station has already had some experience in the propagation of tropical plants especially those of economic value. Turning next to Greater Britain there also, unfortunately, we find no facilities are provided for the agricultural education or technical training of the planter, such facilities as do exist in the tropical regions being intended entirely if not exclusively for the benefit of the native races. I believe, however, that under Dr. Morris's scheme of agricultural education for the West Indies opportunities are to be given to the younger generation of planters and the sons of planters to study "the scientific problems which underlie the practical work in which they are daily engaged."

There are many in this country, I think, who at some period in their life have had to ask themselves the question—can a training for a life career in Greater Britain, as a farmer or a planter, be obtained in England? That for a planter is, I should say, practically unobtainable, as the soil, climate, vegetation, and conditions of life and work with us are not the same as in tropical and subtropical countries. Perhaps it is from this very cause that, as Sir William Des Vœux has pointed out, we are said to be most subject of all colonisers to entertaining delusions about tropical cultivation. "The luxuriance," he states, "of the tropical virgin forest appeals to the colonising enthusiast chiefly as indicating possibilities of its succession by equal luxuriance of plantations controlled by planters. In imagination he sees the 'jungle,' 'bush,' or 'scrub' replaced by fields of sugar, cotton, or tea, judging in doing so, of the cultivation and vegetation of the tropics by the conditions common to the temperate zone." As regards planting, then, it

would appear that the only education or technical training available is by the system under which young men are placed out with planters to be taught the management of an economic plant in all its stages, from the seedling in the nursery to the shipping home of the ultimate commercial product.

There still remains a part of the original question to be examined, namely, can a training for farming in the Colonies be obtained in England? Those who intend to settle and farm in the Colonies can usually, I think, be divided into two classes—those who have been brought up in rural districts and from an early age have been accustomed to farm and manual labour, and, on the other hand, those brought up in urban districts unaccustomed to farm labour, and often even to labour in any form. In a way, as far as I can gather, this distinction is to some extent recognised in this country. Those who are acquainted with and accustomed to the practical work of agriculture can find institutions in England at which they can study simply the science of agriculture. At the same time those who have no acquaintance with the details of agricultural practice will be able to find institutions, where besides studying the theory of agriculture, they will also be instructed as regards its practical details, taking part in all the operations and processes which go to form the yearly cycle in farming. Turning now to the Colonies, what appears to be a general feature there is, that in the agricultural colleges of Greater Britain it is assumed that the student who seeks instruction is unacquainted with practical farm work and, therefore, practical work or manual labour must be undertaken or performed by all and is a part of the instruction offered.

The agricultural settler in the Colonies as already indicated may have had a rural or an urban training. It is but natural, therefore, that these two differently trained men should approach the subject of "Agricultural Education" from two different standpoints. In the one case, considering that both the theory and practice of agriculture has to be learnt, it would seem that the most advantageous way to undergo such instruction would be in the college of the colony where settlement was intended. On the other hand, one cannot but admit the justice of the other view held, namely, that the practical man who desires to study chiefly the higher scientific problems which underlie the practice of agriculture before he entered upon colonial life would find it to his advantage to do so in England, where he can command the best teaching talent, material and equipment. Still there is one factor which must not be overlooked by the most practical man who has further benefited by an expensive agricultural education in England, and that is the time and money that must necessarily be spent by him in obtaining colonial experience in the colony he has chosen. Colonial experience being a term which indicates the knowledge that is absolutely necessary for bringing undertakings entered upon with entirely new surroundings to a successful issue, includes experience in "the clearing of bush lands, the preparation of virgin soil for cultivation, the dealing with the heavy timbers of the colony, whether for use or destruction, the varied modes of cultivation and manuring consequent on the peculiarities of soil and climate and methods of clearing and reaping, the different systems of fencing, the handling of large herds of cattle and flocks of sheep, the local buying and selling of the stock and produce, and the treatment of wool, timber, meat, fruit, bark, butter and other produce for export." It will be readily seen, therefore, that this "colonial experience" is the difficulty that has to be surmounted, and, of course, it will be just as readily observed that a training at a colonial agricultural college, theoretically, should give the knowledge and experience usually so much in demand and sought after.

This leads me to what is the main object in this paper—a survey of what our colonies and dependencies have attempted and accomplished in respect to agricultural education. I cannot pretend to be able to give a complete record of what is being done in the British Empire, but I have attempted by correspondence with the chief officials of our various colonies and dependencies, and by a careful study of numerous reports to be found in the libraries of the British Museum, Colonial Office, and India Office, assisted also by the good offices of the various Agent-Generals in London for our colonies, to gather together some authentic information on the subject.

Leaving England, then, and going to the great American continent, the first country there of importance for us is the Dominion of Canada. I have been favoured with a memorandum relating to agricultural education in Canada, which has been drawn up by Dr. Saunders, Director of the Dominion Experimental Farms, as follows:—

"Information relating to agriculture in Canada is given to the farming community by both the Provincial and Dominion Governments.

"Provincial Aids.

"1. *Agricultural Schools.*—Some of the provinces maintain agricultural schools for the practical education of young men in farming. The Ontario College of Agriculture at Guelph, Ont., is the best of these institutions in Canada. It is well-equipped and well-managed, and has been in operation for about 25 years. There a large number of the sons of Canadian farmers receive practical training in their calling. An experimental farm is also carried on in connection with this institution. The full course of study covers a period of three years.

"In the province of Quebec there are several smaller agricultural schools in different parts of the province, the most important of which is located at Compton, Quebec, in connection with an experimental farm.

"A School of Agriculture has been in operation at Truro, Nova Scotia, associated with an experimental station, for ten or twelve years past, and in the same province a School of Horticulture has been in operation for the past three or four years at Wolfville, N.S.

"2. *Other Organisations.*—Other agencies which also render valuable help in this connection are Dairy Schools, Travelling Dairies, Farmers' Institutes, Live Stock and Dairy Associations, Fruit Growers' Associations, Poultry Associations, and Agricultural and Horticultural Societies. These are all maintained or assisted by the several provinces, by annual grants, and there are many of such organisations in every province. The members connected with these associations, &c., meet from time to time to discuss matters relating to the branches of agriculture they represent, and the more important papers read at such meetings are published by the provincial governments, and distributed, free of charge, to farmers who desire to receive them.

"Dominion Aids to Agriculture.

"The progress of agriculture in Canada has been greatly stimulated by the organisation and maintenance of experimental farms by the Dominion Government. Five of these farms have been established in different parts of the Dominion. This work was begun in 1887, the institutes being so located as to render efficient help to the farmers in the more thickly settled districts, and at the same time to cover the most varied climatic and other conditions which influence agriculture in this country. The Central Experimental Farm is situated at Ottawa, near the boundary line between Ontario and Quebec, where it serves as an aid to agriculture in these two important provinces. A site for one of the four branch experimental farms was chosen at Nappan, Nova Scotia, near the boundary between that province and New Brunswick, where it serves the purpose of the three maritime provinces. A second branch farm has been established at Brandon, in the central portion of Manitoba; a third at Indian Head, a town in Assiniboia, one of the North-West Territories; and a fourth at Agassiz in the Coast climate of British Columbia.

"At all these farms, experiments are conducted to gain information as to the best methods of preparing the land for crop, and of maintaining its fertility, the most useful and profitable crops to grow, and how the various crops grown can be disposed of to the greatest advantage. To this end experiments are conducted in the feeding of cattle, sheep, and swine for flesh, the feeding of cows for the production of milk, butter, and cheese, and of poultry both for flesh and eggs. Experiments are also conducted to test the merits of new or untried varieties of cereals and other food crops, of grasses, forage plants, and trees; and samples particularly of the most promising cereals, are distributed freely among farmers for trial, so that such as promise to be most profitable may be rapidly brought into general cultivation. New varieties of cereals and fruits are also produced for cross fertilising and selection.

"At the Central Experimental Farm there is a scientific staff engaged in solving such problems as may arise in connection with the chemistry of agriculture, the diseases to which cultivated plants and trees are subject, the ravages of insect pests and the spread of noxious weeds. Experiments are also conducted in the planting of trees for timber and shelter and in the testing of ornamental trees, shrubs, and plants.

"An annual report is published containing particulars of the work done at each farm, and this report is sent, free of charge, to every farmer in the Dominion who asks for it. The annual edition now required to meet the demand is 60,000. Occasional bulletins on special subjects of immediate importance are also issued from time to time as required. A large correspondence is conducted with farmers in all parts of the Dominion, who are encouraged to ask advice and information from the experimental farms, in reference to all questions affecting their calling. Farmers are also invited to visit the various farms, and inspect the work in progress. The officers attend many of the more important gatherings of farmers in different parts of Canada, at which opportunities are afforded of giving fuller information regarding the work conducted and the results achieved from year to year."

As noted by Dr. Saunders, the province of Quebec has several small agricultural schools or colleges. For instance, the schools and farms, three in number, belonging to the Corporation of the College of St. Ann's, Richmond, and L'Assomption, have each but one regular professor—that on agriculture. There are many schools also at which the pupils receive lessons in agriculture and horticulture, such as, for example, that at Roberval, Lake St. John, and

at the Monastery of the Good Shepherd, Montreal. In the province of Quebec more also has been done in the way of editing and publishing text-books in various departments of agriculture than in any other province.

Turning now to what might be termed the sister province—Ontario—I find that though between 1870 and 1898 five text-books on agriculture for use in Ontario public schools have been published, yet the Deputy-Minister of Agriculture, speaking in 1898 before the Provincial Teachers' Association, is reported to have said that an interesting discussion might take place on the subject of why the trustees of rural public schools in that province have not insisted upon having instruction given in agriculture. The five text-books in question referred to are one by Dr. Ryerson, one by Professor Henry Youle Hind, one by Sir W. Dawson, the "First Principles of Agriculture," by Dr. Mills and Professor Shaw of the Guelph College, and "Agriculture," by the Deputy-Minister for Agriculture himself. The text-book coming from the Guelph College, I may add, seems to be regarded as the "most perfect and complete text-book of agriculture" published in Canada. In the technical schools also, in this province instruction in agriculture may be given, and a special feature of the School of Mining and Agriculture at Kingston—an institution affiliated to Queen's University — is the dairy school under the control of the provincial government. As Dr. Saunders points out, the best-known institution in Canada is the Ontario Agricultural College at Guelph, which is also affiliated with the provincial university. The course of study at this institution is one of two years for the diploma, which admits to the status of "Associate of the Ontario Agricultural College," with a further course, for associates only, of an additional year which qualifies for the degree of B.S.A. (Bachelor of the Science of Agriculture). The subjects embraced in the two years' course of study are the following:—English and political economy, drawing and book-keeping, mathematics, physics, and mensuration; agriculture, including stock-breeding and rearing, and dairying; horticulture, including fruit-growing, vegetable gardening, and forestry; chemistry, agricultural and analytical; botany, geology and zoology; economic entomology and bacteriology. Those who remain for the third year have to take a general course in English, agriculture, chemistry, geology, and botany; and one special course either in agriculture, dairying, horticulture, biology, bacteriology or chemistry, and physics. A feature of the training the college provides is that the students have to devote their afternoons to practical work outside; from one to five in the winter and one to six during the rest of the year, while during the summer term all students in attendance are required to work at least 10 hours per day and receive pay. Another feature is the scale of tuition fees. All residents of the Province of Ontario who are farmers' sons, or can produce evidence that they have served one year at least on a farm, are charged $20 a year, and those of this class who cannot produce satisfactory evidence of this are charged $30 a year. Outside students, that is, from the other provinces or from foreign countries who can show satisfactory evidence that they have served at least one year on a farm are charged $50 a year; but if they cannot produce this and have had, therefore, simply an urban training, they are charged $100 for the first year and $50 for the second year. This scale recognises, in a practical form, that more care and labour has to be spent in teaching a youth entirely unacquainted with the practices and processes of agriculture, than in teaching one who has already gained only a slight familiarity with them. This college has also a dairying course which lasts for three months, and short special courses in various branches of practical work, which can be taken as convenient.

Before leaving the Dominion of Canada it might be as well to note that in the graded schools of Nova Scotia agricultural chemistry is taught in the rural schools in the summer in the second year. Of the two schools in this province mentioned by Dr. Saunders, it may be of further interest to add that Mr. Mackay, the Superintendent of Education for the province, made the following report in 1897:—

"The Provincial School of Agriculture at Truro, established in 1885, has now two instructors, in addition to the manager of the farm. The attendance in 1896 was 81 for full and special courses, besides the 141 students taking the Normal School special courses. The school has conveniences for the practical study of agriculture and horticulture and dairying. The school building proper is fitted up with qualitative and quantitative chemical laboratories, a dissecting-room, biological laboratory and apparatus, reading-room, and technical library. Under the annual inspection of the school, there are five local agricultural schools in the charge of graduates, who also conduct, in affiliation with the agricultural work, the ordinary public schools of the section.

"The Provincial School of Horticulture at Wolfville was established in 1893, by the Fruitgrowers' Association, with the aid of an annual grant of $2,000 from the Provincial Government. The attendance in 1896 was 67."

In the Province of Manitoba, a course of agricultural instruction has been laid down and a text-book prepared, adapted to the conditions of that province. In British Columbia agriculture has been introduced and made a compulsory part of the curriculum in the schools. There seems also to be a movement in New Brunswick, to have there an Agricultural College affiliated to the Provincial University, and where students may take advantage of certain courses of lectures likely to be helpful to them. All the provinces also employ, from time to time, specialists to go round and lecture in different parts of the country, especially on noxious insects, or "bugs" as they are usually termed.

Leaving the Dominion of Canada, I pass on to what claims to be our oldest colony—Newfoundland. In reply to my inquiries, the Minister of Agriculture in this colony states that he regrets—

"That to all your queries I have to answer in the negative. Agriculture is not taught in any of our schools. We have neither farm schools nor agricultural colleges, neither have we any lecturers nor experiment stations. The Government of this colony appointed a Commission last year to inquire into Agriculture and Industries, and in their report they recommend the adoption of nearly the whole of the methods of agricultural education above mentioned, and I hope that in the near future many of them will be carried into effect."

The Government, however, I find, issues reports dealing with agricultural subjects, and Mr. Moore states that there is an Orphanage at St. John's where the boys are instructed in agriculture as well as in various trades.

The Report of the Commission referred to by the Minister of Agriculture states, that agriculture in Newfoundland is not as yet sufficiently advanced to warrant the Government in establishing special institutions, such as agricultural colleges, farming schools, model farms, and experimental stations, but it recommends instead, "that a modicum of agricultural instruction be imparted in our present schools, and under our present educational system." It is also recommended that the "high schools should undertake to teach an elementary course in agricultural chemistry," and that "in the colleges of the colony should be taught more fully than in the schools already enumerated the technic of agriculture, and a more advanced knowledge of agricultural chemistry." The Commissioners "further recommend that the theoretical knowledge imparted in the schools be supplemented by instruction given by travelling professors or teachers."

It must be borne in mind with respect to Newfoundland that though the agricultural resources of the colony are considerable, yet, in the past, they have been neglected, as the staple industry hitherto has been the fisheries.

Leaving in turn Newfoundland, I now come to the West Indies. Here the economic conditions must be first studied and understood. I have to acknowledge my own indebtedness to Sir William Thiselton-Dyer, the Director of Kew Gardens, for having pointed out to me the scope of the work undertaken in the West Indies in regard to agricultural education, and for having placed at my disposal much of the information embodied in this paper. The aim and object of the agricultural instruction organised in the West Indies appears to be to change the system of cultivating crops on large estates or plantations by a coloured race, directed by a few of a white race, to that of small areas owned, directed, and worked by the coloured race themselves, it being accepted as proved that under present economic conditions plantations and the planting system of agriculture is a failure. It is to bring about this change, as far as I can gather, that the present educational policy as regards agriculture in the West Indies is directed.

It must also be borne in mind that the agriculture to be taught here differs from that of other portions of the Empire—Canada for instance—in being tropical. If a reference, for example, be made to Dr. Alford Nicholls's "Text-book of Tropical Agriculture," published by the Government of Jamaica in 1891, it will be found that the following crops are treated, *i.e.*, coffee, cacao, tea, sugar-cane, orange, lime, banana and plantain, coconut, pine-apple, nutmeg, clove, pimento, cinnamon, ginger, cardamons, pepper, vanilla, tobacco, cinchona, castor oil, coca, jalap, sarsaparilla, anatto, turmeric, logwood, indigo, maize, rice, guinea-corn, cassava, arrowroot, yams, and sweet potatoes; and these are all new to the farmer of Britain or Canada. Some of the tools used are also new to one acquainted simply with temperate agriculture, for instance, the digger or earth chisel and the cutlass.

The two factors that must influence all

efforts in the West Indies are the problems of tropical cultivation and the wants of a native peasantry. The first step taken, therefore, in what might be termed the new era of agricultural education in the West Indies was the establishment and development of the institutions known as botanic stations. These are small and inexpensive gardens devised in order to afford practical instruction in the cultivation of tropical crops, and were first intended to meet the special requirements and develop the agricultural resources of the smaller islands in the West Indies. The first stations started were at Grenada and Barbados in 1886. Since then stations have been started at Antigua, Bermuda, British Honduras, Dominica, Montserrat, St. Kitt's Nevis, St. Lucia, St. Vincent, and Tobago. There are now in all eleven stations in the West Indies and they are in close relationship with Kew.

The next step taken to advance the interests of agricultural education was the establishment at Barbados of an Imperial Department of Agriculture for the West Indies, with Dr. Morris as Commissioner. As regards agricultural education this department has three objects in view :—

"(1) To start industrial schools for training boys in agricultural pursuits. (2) To encourage the theoretical (and to some slight extent the practical) teaching of agriculture in elementary schools. (3) To promote the teaching of scientific agriculture in colleges and schools."

I have been favoured with an advanced proof of the second West Indian Agricultural Conference which was held at Barbados on 6th January, 1900. In his opening address I note that Dr. Morris says :—

"The scheme of agricultural instruction suggested to meet the immediate requirements of elementary schools aims first of all at rendering the existing teachers competent to give simple object-lessons bearing on agriculture and illustrate them by experiments and actual specimens. Examples of growing plants should be grown in pots and boxes under the eyes of the children, and every stage of their growth as well as the conditions favourable for rapid and successful development should be clearly explained. This much is within the reach of the poorest school in the West Indies. All, however, depends on the amount of knowledge and the interest thrown into the subject on the part of the teachers. It is proposed to assist the teachers at present in charge of schools by affording them the means of attending courses of lectures during their holidays. While attending these lectures all out-of-pocket expenses (except in British Guiana, Trinidad, and Jamaica) are paid by the Imperial Department of Agriculture. Lectures to elementary teachers were started last year at Trinidad, St. Lucia, and Barbados, in each case with singular success. They will be continued next week (January, 1900) at Tobago, Grenada, St. Vincent, and Dominica. The teachers so far have shown themselves most anxious to acquire knowledge of the principles of agriculture, and it is anticipated that during the next two years most of the existing teachers throughout the West Indies will have passed through the initial course of training. The teachers now at the training colleges and all future students passing through such colleges should be fully instructed and be competent to teach agriculture before they are placed in charge of schools. For the present Blackie's 'Tropical Readers,' Books I. and II., are recommended for use in schools, but great care is required to prevent mere book knowledge which is worthless taking the place of the intellectual education and the hand and eye-training necessary for agricultural pursuits."

Dr. Morris further states that—

"As a higher stage in agricultural education it is proposed to maintain agricultural schools—the first at St. Vincent, St. Lucia, Dominica, and St. Kitts. The boys will be fed, clothed, and trained free. Admission to these schools will be offered as an exhibition to boys in elementary schools of about 14 years of age who have passed the Fourth Standard and who show moral and intellectual aptitude for such instruction. We have next the scheme of instruction in agriculture to boys in Secondary and High Schools assisted by the special lecturers in agriculture provided by the Imperial Department. At the same schools scholarships are offered to boys from the country districts, the sons of planters in moderate circumstances, who intend to devote themselves to agricultural pursuits. Lastly, there are lectures to the younger generation of planters and others engaged in agricultural pursuits to afford information and assistance in elucidating the scientific problems which undertake the practical work in which they are daily engaged."

So far, then, this describes what has been done generally in the West Indies in the interests of agricultural education. The work done specifically in some of the islands might also be mentioned. For instance in Jamaica there is now a Lecturer in Agricultural Science, and at the Hope Industrial School practical lectures in agriculture are given by the Superintendent of Hope Gardens. The Jamaican Education Department also offer, by grants, assistance to elementary schools for the teaching of agriculture as a special subject, and a practical elementary text-book of tropical agriculture for use of the schools in Jamaica has been published. In addition, it is stated, that all country schools are expected to teach the elementary principles of agriculture

as a part of the general course. Two Jamaica readers — "tropical readers" — have been brought out by the Board of Education, and a supplementary reader in tropical agriculture is in contemplation. In the training colleges for teachers, the principles of agriculture are required to be taken up in the second years' course. The question of providing higher agricultural education for those who may become proprietors and managers of estates has not yet been touched in Jamaica.

Coming next to the Leeward Islands, there is a botanic station at St. Kitts Nevis, but no attempt is made to teach agriculture in the schools there or at Anguilla.

Antigua, I find, has an officer who is called the agricultural superintendent of sugar-cane experiments. Formerly there was here a department of agriculture for the Leeward Islands under a scientific superintendent. It was founded in 1891, and abolished in 1894.

At Dominica there is an agricultural instructor attached to the botanic station, also an agricultural school with a qualified officer in charge. There is also an agricultural instructor attached to the botanic station at Montserrat.

St. Lucia is another island which has an agricultural instructor, and there is one also at St. Vincent. The latter island has in addition an agricultural school in charge of a separate officer.

At Barbados there is a Lecturer on Agricultural Science, and a Professor of Agricultural Science at Harrison College, Bridgetown, who also holds the position of Island Professor of Agricultural Science. Agriculture is also taught practically at the boys' reformatory school at Dodds.

At Grenada efforts are being made to teach agriculture theoretically in the elementary schools, and to start school gardens, and also to utilise the services of the Curator of the Botanic Station to give lectures and demonstrations.

Tobago has a cacao instructor attached to the Botanic Station, but agriculture is not taught in the schools. Neither is it taught in the elementary or industrial schools of Trinidad. It is stated, however, that lectures on agriculture are given at the Victoria Institute, Port of Spain. According to Mr. Moore, instruction in fruit and banana cultivation is also given in this island, and the school teachers are provided with various agricultural publications.

In British Guiana there is an agricultural assistant attached to the Botanic Gardens at Georgetown; and the Royal Agricultural Society in this colony, I am informed, approached the Governor in Council in 1898, with the view of having an agricultural school and experimental farm established, and also of having plots of land attached to country schools, where pupils would spend a portion of their time daily in learning practical agriculture.

Leaving the islands of the West Indies, and the Crown colonies on the mainland, I now proceed to notice the several self-governing colonies which form the Australasian section of Greater Britain.

In the mother colony of New South Wales, agriculture is taught in the State schools, either under object-lessons or natural science. It is also an optional subject for teachers in the series of examinations they undergo to obtain promotion from one grade to another. An agricultural text-book, for use in the schools, has also been published, and an itinerant lecturer on garden and farm work visits the more important schools.

Under the scheme of technical education, also, carried out in Sydney and various country towns, courses of instruction in agriculture, sheep and wool-classing, wool-sorting, and veterinary science are provided.

Agricultural education, pure and simple, is, however, in the hands of the Department of Agriculture. There is, under this department, the Hawkesbury Agricultural College, with experimental farm attached located near the town of Richmond. The complete course of instruction at this institution covers a period of two years of four sessions, and the subjects taught are "practical agriculture, principles of agriculture, agricultural chemistry, botany, geology, entomology, farm-book keeping, veterinary science and practice, arithmetic and English, elementary surveying and mechanics." The practical work at which all students have to engage in is noted as follows :—

"(1) Milking cows, making butter, use of dairy appliances. (2) Killing and dressing sheep. (3) Carpentering work, such as mortising and cutting tenons, setting out roof. (4) Blacksmith's work, welding iron, making bolts, fitting and putting on horse-shoes. (5) Fencing, mortising posts, putting up wire or other fences. (6) Yoking up and driving bullocks, horse work, hay loading, farm implements, engine work."

Though the Hawkesbury College is the only one in the colony where the whole science and practice of agriculture is taught, the scheme of education originally formulated embraced

the establishment of "certain farms and orchards typical of the most important climatic regions of the colony, where those who did not desire to undertake the comprehensive training of the college might be instructed purely in the practice of the various branches of agriculture."

Four such experimental farms have now been established. The Murrumbidgee Experimental Farm, near the southern town of Wagga-Wagga, represents the comparatively dry Riverina region; the Wollongbar Experimental Farm, in the Richmond River district, is in the sub-tropical region; the Bathurst Experimental Farm represents the western plains and colder portions of the colony; while the experimental farm at Coolabah, in the Bogan Scrub, has been established for experiments in the arid portion of the colony.

In all these experimental farms lectures on agriculture are given, and the course is for a year of two sessions. Students at the central college are advised to continue their course at one of these farms, for the student there is "afforded some practical experience of the cultivation of land in a climatic region typical of that in which he intended to settle." According to the Minister for Agriculture, "training at college would provide him with a general and practical acquaintance with farming in all its branches, but to enable him to become (for example) a successful western New South Wales cultivator, a little practical experience of dry country methods is absolutely necessary."

Additional means of imparting information and instruction is further afforded by the employment of a dairy expert, a fruit expert, a viticultural expert, and a travelling agricultural instructor, who, for a number of years, was principal of the Agricultural College. An *Agricultural Gazette* is now published, which in value approaches some of the publications issued by the United States Department of Agriculture—a department which is generally admitted to be the best organised and most practical of any Government in the world. In passing, I may note that I find it stated in the Report of the New South Wales Under Secretary for Agriculture, 1899, "that amongst the 100 odd young men undergoing the full course (at Hawkesbury College) are several from England, Cape Colony, the neighbouring colonies and Japan."

Respecting Queensland, the Agent-General for the colony has been good enough to reply to my enquiries as follows:—

"1. Agriculture is not taught in the elementary schools of the colony, but

"2. Four State bursaries are granted, giving free board and instruction to resident students for three years at the Government Agricultural College at Gatton. Admission is by competitive examination in reading, writing, arithmetic, English composition, geography, mechanics, and drawing to scale. Candidates for these bursaries must be between 16 and 18 years of age, of sound constitution and good health, and themselves must have resided in the colony two years and their parents three years preceding the examination.

3. The Agricultural College at Gatton was established in July, 1897. The college farm or ground comprises an area of 1,692 acres. Dormitory accommodation is provided for 56 students. The buildings include a chemical laboratory and lecture room. The fees, which cover instruction, board, washing, room, rent, and lights, are £25 per annum. The students are engaged for one half the time at manual labour, a day of out-door work alternating with a day of study.

"4. Experts in dairying and other subjects are employed by the Department of Agriculture to travel throughout the colony and give personal instruction to farmers. Bulletins on various subjects of interest to farmers are also issued by the Department, which, with the *Queensland Agricultural Journal*, are freely distributed."

It is a matter of regret to learn that agriculture is not yet taught in the schools of this colony, for, in the paper read at the International Congress on Technical Education by the Emigration Agent for the Colony of Queensland, it was stated that lessons in agriculture had been introduced into the programme of instruction for country schools, with practical lessons in horticulture, for the school children of Brisbane and suburbs. Queensland is, however, peculiarly situated, as within its borders both branches of agriculture are carried on—the tropical and the temperate.

The college lately established is near Brisbane, and the three years' course of study includes the following subjects:—

First Year. — Agriculture, horticulture, dairying, carpentry (industrial), agriculture, horticulture (lectures), arithmetic, book-keeping, chemistry, drawing, English composition.

Second Year. — Agriculture, horticulture, dairying, blacksmithing, (industrial), agriculture, horticulture, dairying (lectures), anatomy and physiology, botany, chemistry, entomology, geology, physics, surveying.

Third Year. — Industrial (special work), agriculture (lectures), agricultural chemistry, bacteriology, botany, landscape gardening,

meteorology, mechanics, veterinary science zoology.

There are also four State Farms in Queensland, at Westbrook, Hermitage, Gindie, and Beggenden, and their object is to carry out experiments for the benefit of the farming community in the district where they are located. (Unlike the farms in New South Wales, facilities for students gaining experience are not afforded at these Queensland State Farms.) Agricultural education is also furthered by the employment of instructors in fruit culture, viticulture, tobacco culture, and coffee culture, and the issue of various publications.

Passing now to Victoria, it may be said that agricultural education in this colony follows very much on the same lines as that of New South Wales. Agriculture can be taught in the State schools, and it is an optional subject in some of the teachers' examinations. It used to be taught in the State School Teachers' Training Institute before that institution was abandoned. Lectures on dairying are being given at present in the country schools, and proving a success. Nothing, however, has yet been done in regard to school gardens, or the practical demonstration of agricultural principles in rural schools, as is done in South Australia. In the Schools of Mines throughout the colony both agriculture and agricultural chemistry may be taught, and the curriculum of the Victorian Technical Schools includes agriculture, fruit-growing, and veterinary science. A Royal Commission, I may note, has lately been appointed, and is now dealing with the present educational system of the colony, and investigating as to the best systems of technical and agricultural teaching, as found in Europe and America. The whole system of teaching in the colony is, therefore, likely soon to be remodelled.

The interests of purely agricultural education are in this colony entrusted to a Council of Agricultural Education, which represents the Agricultural Societies and the Government. Two colleges have been established by this Council—one at Dookie, in the north-eastern district and near to Shepparton; the other at Longerenong, in the Wimmera district, and near to Horsham. The latter college, which is placed near the Mallee lands, and admirably adapted for demonstrating what can be done in farming with irrigation, has been, however, closed for some time, but it seems to have been only a temporary measure, for I believe it is now again ready to receive students. It was originally intended, I believe, to found two more colleges one in the south-eastern and the other in the south-western districts, but this intention has not been carried out. The great feature in the colleges controlled by the Council of Agricultural Education in Victoria is that the instruction is free, the only charge being for maintenance. It is optional with students to remain one or more sessions at the colleges, but before a student can obtain his diploma he must have been in attendance for at least two years, while the maximum term of attendance permitted is three years. The course of instruction is the same in both colleges, and comprises elementary chemistry, botany and geology, some agricultural chemistry and economic entomology, advanced English to the understanding of technical expressions, arithmetic, mensuration, surveying, book-keeping, practical work on the farm, instruction in field operations, the use of farm implements and machinery, and the management of stock. Very special prominence is given to practical work at these colleges, and half of the students' time is devoted to field work. All students must be over the age of fourteen on admission and each college has accommodation for forty students.

A new school of viticulture has recently been established at Rutherglen in the north-eastern district and is directed by an expert from the college of viticulture at Montpelier, France. A school of horticulture has also been in operation for many years at the Government Horticultural Gardens at Burnley, near Melbourne. Here the number of students is limited to 25, and the term is also restricted to one year, the instruction being free. A Government scent farm was also carried on for some years to give instruction in scent flower farming, but is now closed for the time being, as sufficient interest was not taken in the industry. A small experimental tobacco farm has, however, been recently established near Wangaratta by the Government tobacco expert, who was engaged from the United States, and for the past two years has been giving instruction to growers. It is now proposed, I am informed, to extend still further the scope of agricultural education by the establishment of a dairy and cheese school, and a large sum of money has recently been voted for the purpose, so that these institutions will probably be established shortly. Like the other colonies, Victoria also employs experts to give instruction in dairying,

fruit growing, viticulture, tobacco growing, and the cultivation of fibre and oil-producing plants, and issues bulletins.

Next I note what has been done in respect of agricultural education in the adjoining colony of South Australia. Though this colony extends through the continent, and within its boundaries you find tropical, sub-tropical, and temperate cultivation, education in agriculture is limited to the southern portion of the colony. In reply to my enquiries, the Agent-General for the colony, who when in South Australia was mainly instrumental in introducing the teaching of agriculture into the State schools, was good enough to advise me that—

"(1) Agriculture is taught as a specific subject in the elementary state school, in the *country*. (2) There are no farm schools, but several secondary agricultural schools for lads of 12 or 13 years. (3) We have the Roseworthy Agricultural College, and one high technical school of agriculture. (4) The study is encouraged in primary schools, where teachers can raise the per-centage of their results by teaching agriculture and similar subjects."

The technical school of agriculture mentioned was opened in 1898 in Adelaide. At this school the subjects taught are English literature, composition, advanced arithmetic, algebra, plane geometry, mensuration and land surveying, mechanical drawing, agriculture (theoretical and practical), fruit culture, and viticulture. For instruction in chemistry, physics, and carpentry, the scholars attend the School of Mines. Students from the Teachers' Training College also attend this school to get from the master a practical insight into the methods of teaching agriculture, so that in due course they may be appointed to schools where instruction in agriculture is to form an important feature of the work. From the report of the South Australian Minister of Education for 1898, it seems that the Board of Inspectors in the colony are in favour of the teaching of agriculture in the schools. This deserves notice, for a study of the reports of the Departments of Education in the other colonies will show that a good deal of opposition to the introduction of agricultural teaching in these colonies has come from members of the Inspectorate.

Passing next to the technical schools in South Australia, their curriculum also includes wool sorting and dairy work as subjects of instruction. Turning now to purely agricultural education, like the other colonies already mentioned, South Australia has an Agricultural College, located at Roseworthy, about 35 miles from Adelaide. This college was opened in 1885, and the course of instruction includes practical agriculture, chemistry, botany, geology, surveying, levelling, mensuration, book-keeping, entomology, and veterinary science, and also viticulture, œnology, fruit culture, and wool sorting. The course is a two years' one, but students who fail to obtain a diploma may remain a third year. The age for admission is 14, and all students are required to take part in farm work; but only half the time considered necessary in the Victorian colleges to be devoted to practical farm work is insisted upon at Roseworthy. The laboratory and science teaching generally is, however, recognised to be at Roseworthy in advance of that at the Victorian institutions. Again, like the other colonies, South Australia employs experts to give instruction in viticulture, horticulture, and dairying, and publishes a journal.

The last colony on the Australian continent yet to be mentioned is Western Australia, the Agent-General of which advises me that:—

"(1) Agriculture is partially taught in the State schools of Western Australia. (2) There are no farm schools in the colony. (3) At present no agricultural school exists, but the desirability of establishing such a college has been brought before the Government. (4) The Educational Department encourages agricultural training in the State schools."

I have been unable, however, to learn in time for this paper how agricultural training is encouraged, and what methods of teaching agriculture are employed in the State schools of this colony.

Coming now to Tasmania, this colony has what is termed a "Practical School of Agriculture" at Ulverstone, on the north-west coast. This school is under the patronage of the Tasmanian Government, and has been selected by that Government to afford technical instruction in agriculture in the colony, and is subsidised also by the Government in order that special classes may be held at a low fee, open to farmers and others in the district. Unlike the other Australian agricultural schools or colleges, it is not a Government institution. The basis or foundation of the school is the Ulverstone Grammar School, to which first an agricultural side has been added for boys, and then a further addition of a distinct and separate branch, including a farm, for grown up students. Agriculture is not taught in the elementary schools of this

colony, but theoretical tuition in agricultural chemistry is sometimes given in the higher grade schools or colleges, though nothing of a very definite nature is taught. Occasionally lecturers are engaged to travel through the country and give instruction on agricultural subjects. There is also what is practically a Department of Agriculture, which issues publications, and can command some scientific advice.

In New Zealand the circumstances are different, for agriculture can be taught in the elementary schools in Standards IV., V., and VI., and its teaching is encouraged by a provision that "if agricultural chemistry be efficiently taught, no other elementary science shall be required in these Standards." I have already drawn attention to the favourable opinion held of agriculture as a subject of instruction by the South Australian Board of School Inspectors, but in the report of the New Zealand Education Department, 1898, I find the reverse of the picture. The Chief Inspector, for instance, in his report, says, "The general science course is again being taken up in a good many schools where agricultural science was formerly preferred. This is a change to be welcomed, for the educative value of the two courses, and the facilities they offer for experimental illustration, are very unequal." In the same paragraph he further states that "with history treated only as a subject for reading, and the extravagances of the syllabus in geography, higher arithmetic, and agricultural science rigidly pruned, there would be time to do honest educational work all round, and little excuse but incapacity for not doing it." This is, of course, a matter for debate among experts. I simply regard it from what might be termed the ordinary ratepayers' point of view, and would say that the teaching of agriculture in the schools cannot be successful when the subject is regarded by the inspectorate in the light these extracts indicate. Like the neighbouring colonies, New Zealand also has an Agricultural College at Lincoln, near Christchurch. This college is one of the affiliated colleges of the University of New Zealand, which grants certificates and a degree (Bachelor of Science) in agriculture to those students who follow the prescribed course and pass the necessary examinations. For the degree in agriculture a student must first pass the matriculation examination, attend two years at a university college, and then two succeeding years at this Agricultural College. The course of instruction at Lincoln extends over two years, and students are not received if under sixteen years of age. The students' time is also equally divided between lectures and practical work as follows:—On one day the first-year students receive lectures, and the second-year students work on the farm; on the following day the second-year students receive lectures, and the first-year students work on the farm, and so on. The subjects taught are agriculture, chemistry, general and agricultural; botany, general and practical; entomology, general and agricultural; geology, physiography, and meteorology; veterinary science, applied mathematics and mechanics, land surveying and levelling, drawing, and bookkeeping.

In addition to this general agricultural college, a dairy school is about to be established, and instructors from Canada have already been appointed.

As regards the technical schools of the colony, agriculture, according to the report for 1899, was only taught at one institution, the students being examined in the subject under the English Science and Art regulations.

This colony further employs three dairy instructors, three fruit experts, and one poultry expert, and has a number of experimental stations, including two poultry - farming stations; and the Department of Agriculture freely distributes leaflets and pamphlets of interest to agriculturists. This free distribution of information with the object of educating and assisting those settled on the land, one might add, is a feature common to all the colonies of the Australasian group. Before passing on from this group to the next, that is to the East Indian, I would note, so as to complete the Australasian group, that there is a botanic station in Fiji, and a technical school at Viti Levu, where the native is taught the rudiments of agriculture, *i.e.*, how to propagate and grow food and economic plants.

Coming to the next group, the same change in the object of the agricultural education provided has to be noted as was remarked when passing from Canada to the West Indies. The agricultural education provided in the East Indies, is likewise intended for the benefit of the natives of the country, and no provision is made for those who represent the planting industry. The European must, therefore, learn by experience the details of his calling as a planter. The East Indian planters in some respects, I venture to think, differ from the planters of the West Indies. They can be

roughly divided into two classes or groups. There are those, for instance (generally engaged in the tea or coffee industry), who have to manage a large estate, control a large number of native labourers, and be responsible for the economic plant grown from its nursery stage, till, so to speak, its produce is harvested, and then, still further, have to direct control and be responsible for the manufacture of this product into a commercial commodity. On the other hand, there are those, who (usually engaged in the indigo or sugar industry) have, under contract, the economic plant grown for them by native tenants or proprietors, and accept no responsibility till the natives harvest the produce, and place it in their hands to be manufactured into a commercial product. The former group, obviously, is more in need of a good agricultural training than the latter, and the question naturally arises why it has not been provided. Of course, I assume that it will be granted that a training in temperate cultivation under temperate conditions is not suitable, and that the system of pupilage which is practically that of apprenticeship, under a manager who may be good, bad, or indifferent, is not regarded as one capable of affording the best results.

Taking the Straits Settlements as the first of the East Indian group, I would note that, acccording to Mr. Moore, a Malay translation of an English book on the "Principles of Agriculture" is used as a reading-book in the native schools, while in the English schools, agriculture is one of the extra subjects of the Code.

In India and its dependencies a good deal of interest has been taken lately in agricultural education by the Supreme and Provincial Governments. I have been favoured, by the courtesy of the Under Secretary of State of the Government of India, Department of Agriculture, with a copy of a resolution issued by the Department, which shows the progress of agricultural education in India up to 1896.

I will briefly note what has been done. In the Bombay Presidency there is, at Baroda College, an agricultural branch, and lectures on agriculture are given at the Poona College of Science by the Superintendent of the Bombay Government Farms. There is also an agricultural class in connection with the High Schools at Belgaum and Naidad. The University of Bombay further offers a diploma in agriculture, but not a degree. In the Madras Presidency, there is the Saidapet Agricultural College, which has been established for a number of years. In the Central Provinces there is no agricultural college, but at Nagpur there is an agricultural class at the Government Farm.

An agricultural class is also established at the Government Farm, Cawnpore, North-West Provinces. Both of the classes named are utilised by the Education Department for the instruction of training-school students and schoolmasters. The period of the agricultural course is in both places two years, but the course for schoolmasters at Nagpur is only for six months. The Allahabad University has also so far supported the Cawnpore farm class in the interests of a supply of agricultural teachers as to allow a special examination on science and agriculture students go up for the "school trial" certificate. It may be added that one of the training schools for teachers in the Bombay Presidency has on its staff an agricultural teacher who has obtained a college diploma, and gives lectures to the students in training on agriculture.

The whole question of agricultural education in India has, I believe, lately been put on a new footing entirely through the acceptance by the Supreme Government of the view that a thorough and practical education in agriculture ending in a high-class college diploma or in an agricultural degree develops the intelligence of students just as well as a literary course, and that it certainly fits them as well, if not better, for duties in the Land Revenue and cognate services. The Madras Government has given effect to this view by making the diploma in agriculture of the same value as a B.A. degree, as a qualification for higher Government service. The supreme Government of India has emphasised this view by placing on record the following conclusion, namely, that "agricultural degrees, diplomas, or certificates should be placed on the same footing as corresponding literary or scientific degrees, &c., in qualifying for admission to Government appointments, and more particularly those connected with land revenue administration."

From the resolution of the Supreme Government forwarded to me I learn that this Government has impressed upon the provincial Governments and the various educational departments the policy of "making instruction in the rudiments of agriculture part and parcel of the primary system of instruction in the country, rather than teaching it as a subject apart from the general educational programme." Perhaps the intention of the

Government of India as regards agricultural education will be more fully indicated if I note three other conclusions that are recorded:—

"(1) That the practice of allowing schoolmasters, either before or after appointment, to pass through a course of a few months on a Government farm is one which deserves consideration.

"(2) That a special school course leading up to the agricultural diploma, degree, or certificate is required.

"(3) That the [agricultural] diploma should eventually be compulsory in the case of certain appointments, *e.g.*, agricultural teachers at training schools, assistants to the director of agriculture, &c."

Before passing from India I may add that it does not suffer from a want of agricultural text-books, there being of late years quite a respectable number published both in English and the vernacular. The Government agricultural publications are also many and of service not only to the native cultivator but to the European planter.

In Ceylon the elements of agriculture are taught as a specific subject in the Government schools, and a primer of agriculture has been published by the Director of Public Instruction. There is also a school of agriculture at Colombo which was opened in 1884, and has ten branch institutions. From this school, to which a dairy is attached, agricultural instructors are sent into remote rural districts to illustrate improved methods. The school for a number of years has also issued a monthly magazine and this along with the *Tropical Agriculturist* furnishes the agricultural literature of the colony, a colony, I may add, which has the reputation of being itself the best training ground for the tropical planter.

Our next group is the African. Here the first thing to be noted is, that following the example of the West Indies a number of botanic stations have been established. The earliest was started in Lagos in 1888, the next being at Aburi on the Gold Coast, the rest being located at Uganda, Gambia, Sierra Leone, and in the Niger Coast Protectorate. These African stations, along with the Fiji station already mentioned, have a different mission to fulfil from those in the West Indies. They are teaching stations; in fact, they are intended to instruct natives in the rudiments of what is for them, practically, an unknown art. In the West Indies, on the other hand, they are intended to assist the peasant population to put to profitable use an art they already know and possess. In British East Africa, besides the botanic station located in it, the European cultivation introduced by the missionaries may also be regarded as of educational value to the natives. Zanzibar, again, has a Director of Agriculture, and his work on the same basis may be regarded as educational. To British Central Africa the European planter has penetrated; and at Zomba there is a Scientific Department to assist in working out the problems in pioneer cultivation that incessantly arises. Passing to Mauritius, I have to refer to Mr. Moore, who states that an attempt to start agricultural schools, and to introduce the study of agriculture in the rural primary schools of this colony, fell through for want of funds.

I come now to the two self-governing colonies in South Africa. Natal has a Department of Agriculture, and employs both dairy and irrigation experts, but no school or college of agriculture has been established. Under the Natal system of school education, however, agriculture is to some degree studied. Field work on a farm or garden, for instance, is compulsory in all the native schools, and the last report of the Superintendent of Education (1898) shows that even in native girls' schools land is cultivated and garden work done by the girls. From this report I also learn that the principles of agriculture were taught in three European schools. In the Government school at Estcourt they were taught to the boys and girls in Standards VI. and VII. At the Government school at Verulam they were taught to the boys in the same standards, and in the Government school at Ixopo they were taught to the senior pupils. The examination is not colonial, but under the regulations of the English Science and Art Department. In South Africa some of the conditions differ from the other colonies in America and Australia. For instance, native labour is available, and the native has to be taught to labour on a farm, that is, do field work, for usually he is too backward for any other kind of agricultural teaching. Again, the European farmer stands somewhat in a different position from the farmer, for example, in Australia, as he often has at his disposal, and can utilise, the labour of the natives.

Passing on to Cape Colony, I might just note that the Agent-General for the colony in London advises me that he is unable "to say precisely to what extent agriculture may be taught in the elementary schools, because many of these are not under official control." The Blue-books of the colony indicate that to some extent it is taught, and for some years it

has been an optional science subject for teachers. In the Report of the Superintendent-General of Education for 1898, for instance, it is stated that not a single candidate had been presented for examination in agriculture, which Dr. Muir adds, "in view of the large total (318 as against 250 in 1897) is decidedly disappointing."

Placed under the control of the Education Department of Cape Colony are two agricultural schools—one at Elsenburg, the other at Somerset East. The latter school, the Superintendent-General of Education reports, "has been allowed to linger on without alteration." These agricultural schools, I may add, were formerly three in number, and under the Department of Agriculture, and have only lately been transferred to the care of the Education Department. One of the three has, however, been given up for some time, and now it would seem that another will soon follow.

The Elsenburg School of Agriculture at Mulder's Vlei is, in a sense, a new venture, which was only opened in September, 1898; yet it represents the old Stellenbosch School of Agriculture which moved from there to this farm. The Principal, like the school, is also new, having been selected in England to start the new experiment. The school, as remodelled, is intended for boys of the better class, and the entry test is the fifth standard of the ordinary school. The work done in the agricultural schools, formerly, was mainly theoretical. The school at Elsenburg is an admitted experiment to see if an institution where practical instruction is given in farm work gives better results than the former semi-theoretical and scientific schools. At Elsenburg, with this object in view, the students have now to devote their afternoons to practical farm work.

The Department of Agriculture at Cape Colony has a wine farm at Groot Constantia, employs experts and agricultural assistants, and issues an *Agricultural Journal*. This completes, I think, what the Cape furnishes in respect to agricultural education.

As regards the rest of the African Continent, there only remains for me to mention that practical agriculture is taught in the mission schools at the Gold Coast. Boys from the Government schools are also trained at a model farm. There is, further, on the West Coast, a scheme of agricultural instruction formulated, covering three years, by which, beginning with a year's work at a local botanic station, a selected pupil then proceeds for a year's work in Jamaica, and finishes his final year at Kew Gardens.

Coming nearer home, at Malta agriculture is not taught in the primary schools, but the Third Reading Book contains short lessons on agriculture. Beyond this, agricultural education does not seem to receive any support. Cyprus also does not appear to have made any provision for affording instruction in agriculture. The aid may be given indirectly, however, for in 1896 Mr. Gennadius, who was formerly Agricultural Adviser to the Greek Government, was appointed Director of Agriculture in this colony.

In making this survey, I have now journeyed right round the world, following the common flag of Greater Britain. Our position in this country is, however, a peculiar one, in respect to agricultural education and many other things, for we are both a great Colonial Power and, at the same time, an assertive Free Trade nation. This, therefore, invalidates any useful comparison being made between ourselves and other nations, and such I do not intend to make. A witty writer has said that our population is brought up "upon grammar and ready-made goods." In Greater Britain these "ready mades" of whatever nature are not so easily obtainable as here, for it must be borne in mind that in young countries the division of labour is not so complete as in the older ones, and, therefore, every man, in some slight degree, is a jack-of-all-trades, the two golden rules of colonial life being that a man should be prepared and willing to do anything; and, if you want a thing done, do it yourself.

I think it will be admitted that even the little information I have been able to present in this paper regarding the work accomplished in Greater Britain indicates that the value of agricultural education is universally recognised in the Empire. Its aim in the self-governing colonies is to benefit the Imperial race, and in the rest of Greater Britain to benefit the native race. The agriculturist in the self-governing colonies, I would add, has, besides all the facilities for gaining knowledge that has already been enumerated the command of services of a large body of scientific men acting as chemists, botanists, vegetable pathologists, bacteriologists, entomologists, &c., in connection with departments of agriculture. Some of the colonies in this re-respect are even better equipped than the mother country.

I have already stated that those who go abroad to Greater Britain with the intention

of engaging in some form of soil cultivation, directly or indirectly, can be arbitrarily divided into two classes—planters and farmers.

As regards the first named, from the survey made it would seem, generally speaking, that agricultural education in Greater Britain is intended almost exclusively for the natives the planter directs rather than for himself. The question thus arises that seeing that planters commonly cultivate tropical and subtropical plants under similar climatic conditions, is a suitable technical training and experience obtainable at home? Further, would the training of an English agricultural school be of any general service to a planter? These questions are undoubtedly open to a good deal of discussion. The second group is the farming class, and again practically the same questions can be formulated. Those who go abroad with the intention of farming find their way into one or other of our self-governing colonies, and they may be arbitrarily sub-divided into two divisions, *i.e.*, those who already have some experience of farm operations and practical farm work, and those who have not. Seeing, then, that in Greater Britain to-day there exist nine agricultural colleges and schools, and that they all make instruction in practical work a distinctive feature of their curriculum, the question is, would both the divisions of settlers just differentiated equally benefit if they studied at these institutions? Two reasons, I think, might be advanced why agricultural institutions giving practically equal time to class-work and field-work are so universal in Greater Britain. The first is that those who have been settled on the land had themselves previously no experience of farm life, and would have welcomed such an opportunity had it been obtainable in their time, and now they judge of others, needs by that of their own in the past. The second reason is that the majority of the pupils who do attend these institutions are admittedly drawn from towns.

Dropping now all arbitrary differentiation the question here again arises, can a training or education for farm life in Greater Britain be obtained at home? Colonial authorities state emphatically that it cannot. To give one illustration in support of this statement, I may say that I find in "The Government Handbook of Victoria" it is stated, with respect to agricultural education, that "there are institutions in England which profess to give an agricultural education fitting young men for colonial life, but the training obtained under such circumstances must be very defective. The knowledge of colonial conditions must be wholly theoretical, and the time spent in such institutions is likely to be almost entirely lost." Here is an authoritative statement, but, of course, it must be borne in mind, and due allowance be made for the fact that the Government in question, like other Colonial Governments, have colleges of their own into which they naturally desire to attract intending settlers. Undoubtedly the practice of Canadian, Australian, and South African farming is not as ours, but then the principles are the same. It matters then little whether it be studied in this country or in some other part of the Empire. The institutions of this country are very naturally better fitted for training English farmers than colonial settlers and the students attending them are not far removed from the influence of home. In the Colonies, on the other hand, and at the colleges there, the youth would be better trained for colonial life, but of course he would have to undergo an early separation from home and friends and all these two words imply. As to which is the best course to follow, authorities differ.

The agriculture of this country is the result of centuries of experience and progress, and has become definite and specialised, but in the colonies agriculture is passing through the experimental stage only. The secret of success in such a stage of agriculture lies in what should also be the watchword of the colonial farmer—adaptability. The colonial settler is called upon to apply in a variety of ways and to adapt to a hundred purposes whatever knowledge he possesses of observed facts, and common or general principles. Here again another question arises which could well be debated, *i.e.*—would an English training give a settler that hardiness, keenness, alertness, handiness, and general long-headedness necessary for action under the inclusive term of adaptability?

I have endeavoured to avoid, as far as possible, interpolating into this paper my personal opinions or views. My aim has been to show the amount of good work that has been planned, and also accomplished in Greater Britain in furtherance of the interests of agricultural education. If I have even partially succeeded in doing this, I venture to think two conclusions can be safely arrived at.

First, that throughout Greater Britain irrespective of climatic, racial, and political divergences, there is a universal movement t

give all interested in the culture of land every opportunity, facility, and assistance possible to improve themselves, their art and craft, and the land and its produce.

Secondly, that the purely educational or teaching facilities in agriculture offered by other portions of the Empire where the general agricultural conditions are somewhat akin to our own are not only so distributed as to cover fairly the area in question, but are also equal in educational value to any of the agricultural training or teaching institutions in this or the other countries of Europe.

These two conclusions I venture to think might be regarded as the logical sequence to the survey made and facts recorded in this paper.

DISCUSSION.

The CHAIRMAN said he felt sure he should have he unanimous approval of all present in conveying o Mr. Wallace their thanks for this paper, which vas rather difficult to discuss within reasonable limits, s its contents were so varied and comprehensive. Still e might be excused for saying a few words on the general conclusions he had attempted to draw from t. At the conclusion, Mr. Wallace had very properly poken of the anomalous character, in some respects, f the agriculture of our own country. Agriculture vas the first and oldest of the arts, and in n old country like England, agriculture was kind of reflection of the national history, inluding even the development of the character f the races that practised it. The agriculture of ngland was traditional, handed down from one eneration of farmers to another, and did not seem to equire on the part of the Government, or even of lucational bodies, any very elaborate assistance the way of instruction. At first sight this seemed aradoxical, and rather to traverse the main argument the paper, but it was not so really, when one onsidered how this state of things had come about. had always appeared to him that English agrilture, which in some respects occupied the first ace in the world, was really the result of our social stem. He would call attention to the rather rearkable paper lately contributed to the Royal atistical Society, by Mr. Reginald Hooker, of the oard of Agriculture, in which he pointed out at looking at the results of British agriculture relation to the number of persons engaged in oducing the crops, and considering it in comparison th the agriculture of other countries, and the actual tput per individual engaged, the result was that eat Britain soared away from nearly every other intry in the world. That was an interesting nclusion, and he ventured to think it had been proced by a process of filtration. We owed all our great advances in agricultural science to our great landlords and capitalists. Men who had ample means and the taste which had always characterised the English aristocracy for rural life, and a desire to do what was best for increasing the produce of their lands—such men as the Earl of Leicester and many others he could name, coming down to Sir John Lawes—had without the assistance of Government or of educational establishments, carried on experiments on a gigantic scale, which had led to the most remarkable development of English agriculture. These experiments were sometimes successful, sometimes not; when successful they were imitated by the larger tenants, and by a process of filtration the same methods came down to the smaller farmers, always being tested by practical success, and in that way our system had been built up on sound lines. He must not, however, be understood to suggest that there was no room for agricultural education in this country. Of late years agriculture had passed through a period of depression. There was a time, not long ago, when farmers were very prosperous, and he was not sure that looking at the development of English agriculture from a scientific point of view the depression had been an unmixed evil, because it had raised problems which in a time of prosperity would never have been raised. For example, when farmers were very prosperous they were very liberal in the use of manures, especially artificial manures, and he had no doubt that large sums were wasted before it was discovered by Sir J. Lawes and Sir E. Frankland that an enormous amount of nitrogen put on the land in the shape of artificial manures went away through the drains. Now that agriculture did not pay there was more scrutiny as to a leakage of that kind. He had no doubt also that an immense improvement would be effected in the manufacture of dairy produce by the development of technical education. At one time the production of really good butter depended entirely on the skill of the dairymaid; sometimes the butter would come and sometimes it would not; sometimes the product was good, and at other times very indifferent, but the whole process was empirical. Now, he understood, that owing to the careful study given to dairy work, there was no excuse for not making butter properly; in fact, a dairy instructor, on visiting a farm and inspecting the process and result, could immediately point out where, if there were any defect, the thing had gone wrong, the manufacture being now brought under scientific control. Still more interesting results had been brought about by the depression in agriculture, and he might refer to one which was due to Dr. Somerville, now Professor of Agriculture at the University of Cambridge. He took up the problem of manuring from the strictly commercial point of view. It occurred to him that when you manured a pasture, the most practical thing to consider was not the effect on the grass, but on the mutton fed on the grass, because you then took the two terms of a purely commercial operation.

When you manured a field with a view to feeding sheep upon it, you had to consider whether the operation was profitable, and Dr. Somerville brought the question to a practical point when he compared the cost of the manure with what the butcher gave for the mutton fed upon the field; and by using different kinds of manure on different surfaces he arrived at what might be called the optimum treatment of a field from the butcher's point of view. This showed that agriculture in this country was not an exhausted art; that there was still room for research and for skill and intelligence to be brought to bear upon it. When they turned to Greater Britain they were faced with problems so complex, that it was almost impossible to make any useful commentary; but in dealing with different parts of the empire they must distinguish the different objects which agricultural education had in view. In Canada, at the Cape, and in Australia, which were largely devoted to farming, settled institutions were of very recent date. There were no great landowners and therefore it was necessary for the Government to do there what was done in England by private enterprise. It was a mistake to think that the whole empire must have one uniform system of government; principles which were sound and not lightly to be meddled with in this country were absolutely inapplicable in other countries where the conditions were entirely different. The absence of a wealthy class of landowners made it necessary in Canada, the Cape, and Australia for the Government to do things which Parliament would never agree to in this country; and to play an active part in the prosecution of agriculture. He was much struck with what was said to be going on in India. He did not see why in an agricultural country, theoretical agriculture should not be the basis of a liberal education quite apart from the practical results which would flow from it. After all it was very doubtful in his opinion whether practical farming could ever be really taught in the lecture-room, but, on the other hand, it did not follow that what was taught in the lecture-room was useless. He thought the Government of India had taken a sound step in giving encouragement to the people of India to acquire the principles of agricultural science. They might or might not be able to give effect to the theoretical ideas they imbibed, but something might be done towards overcoming the inertia of the Oriental mind, which was the great obstacle to any change. In the West Indies they had conditions quite different from anything existing in Australia or Canada. It was not necessary to expatiate on the point that from great economic causes, which were entirely beyond control, the state of things in the West Indies had entirely changed. Instead of having large plantations carried on with large capital and slave labour, they found these plantations falling out of cultivation, and, at the same time, a large free black population, very prolific, and gradually approaching a state of destitution. Within the last two years the Government had decided that that state of things must be dealt with in some definite way, and an elaborate system had been organised for dealing with these people, especially in Jamaica, Dominica, and some other islands, and instructing them in growing bananas, cacao, coffee, spices, and other commodities which must be purchased by merchants, and exported in exchange for such things as were necessary for their comfort; in other words they were trying to create a system of peasant proprietors. Whether it succeeded or not, it seemed to be the only practical remedy for the distressful condition of affairs in that beautiful part of the Empire. In West Africa we had a problem of an entirely different kind. There we had annexed very large territories, where the population had principally occupied themselves hitherto in tribal wars; we enforced the Pax Britannica, and insisted on their settling down and becoming peaceful citizens. It was necessary to give them something to do; and agriculture being the first of the arts, and the mother of civilisation, it was necessary to teach it. The process was tedious, and at present had only met with moderate success. They had, therefore, not merely a survey of the world from China to Peru, but a survey including the very complex civilisation of our own islands, and many countries which had practically no civilisation at all. In all these circumstances, they found the agricultural goddess showering blessings and fertility on the lands over which Mr. Wallace had accompanied her path.

Mr. W. S. Seton Karr said the only portion of the paper on which he was able to offer any remarks, was that referring to India. It was some years since the late Lord Mayo introduced the Department of Agriculture, but since then it had been modified and improved, until it had become an important department of the State. Mr. Wallace was quite right in drawing a clear distinction between the English planter directing the labours of others, and the Englishman who entered on the field of actual cultivation himself. He might say, without fear of contradiction, that it was entirely out of the question for an Englishman to devote himself, in the plains of India, to field work. He might do admirably as a capitalist making contracts with natives, and in the production of tea he had made real progress; but to undertake actual field labour was impossible. The speaker himself, when in the Gangetic valley for some years, devoted considerable attention to practical agriculture, having 30 or 40 acres of garden ground on which he grew nearly every important kind of produce—rice, sugar-cane, indigo, &c., and he made many experiments; and his experience was that what was done by the substantial tenant-proprietor in India could hardly be surpassed by anyone. It was perfectly true that there were instances in which the cultivation was careless and imperfect, where it was carried on by men without resources, but the substantial tenant of Lower Bengal, aided by the climate, when the rain did not fail, produced splendid

crops—the late crop and the early crop of rice, sugar cane, cereals, and so on, and when theorists went to teach them how to manage their land, they soon found they had a good deal to learn. He was far from saying that the Department of Agriculture was not necessary and useful. On the contrary, in order to direct the cultivation of cinchona, tea, and other products, where English capital could be employed, the Department might do a great deal of good. But even in former times a friend of his, who was growing tea in Assam and Cachar, gave him some of the finest tea he had ever tasted. That was more than thirty years ago. It was very proper that Government should encourage agriculture, but whether the educated native of Bengal, who was fond of quoting Milton and Shakespeare, would condescend to take an agricultural degree, was rather doubtful. The person to look to was the substantial tenant-proprietor, and he had done well in the past.

Mr. HEDGER WALLACE, in reply, said he agreed with Mr. Seton-Karr that the diploma in agriculture which had been instituted by the Government of India would not have much attraction for the so-called educated native, who quoted Milton and Shakespeare; but the desire was rather to put him into the background, and obtain a native who would not quote Shakespeare in "baboo" English, but who would be able to tell something of the life and growth of the natural vegetation about him. The Milton and Shakespeare quoting native was not an observant one. He had had some experience as a planter in India, and he knew that that class of native was not an observant individual, and could not compare, as regarded knowledge of the life and habits of common plants, with the ryot who worked in the fields by which he lived. He felt they were all much indebted to Sir W. Thiselton Dyer for his kindness in taking the chair on this occasion.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 7, 1900; Major-General Sir OWEN TUDOR BURNE, G.C.I.E., K.C.S.I., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Douglas, Loudon McQueen, 29, Farringdon-road, E.C.
Cok, Cheah Chen, Green-hall, Penang, Straits Settlements.
Johnston, Thomas, 149, West George-street, Glasgow.
Kendall, Franklin R., 122, Leadenhall-street, E.C.
Hay, Frederick J., 19, Dorville-crescent, Ravenscourt-park, W.
Muir, John, J.P., Mains-house, Beith, Scotland, and 3, Arundel-street, Strand, W.C.
Windle, Charles Howard, Calcutta, India.

The following candidates were balloted for and duly elected members of the Society:—

Bird, George William, Moulmein, Burma.
Doman, William, 129, Cheapside, E.C.
Edward, Alfred S., 46, Fountayne-road, Stamford-hill, N.
Williams, B. Robert, Tarquah Government Railways, Sekondi, Gold Coast, West Africa.

The paper read was—

MACOMBE'S COUNTRY (SOUTH OF THE ZAMBESI), ITS ANCIENT GOLD-FIELDS AND INDUSTRIAL RESOURCES.

By DR. CARL PETERS.

I intend to lay before you to-night some of my discoveries and explorations I have carried out last summer in the Zambesi district. I will try and give you a rough sketch of Macombe's country, its ancient gold mines and industrial resources. Before doing this, permit me to explain briefly to you how my attention was directed to this part of Africa.

In the year 1895, I visited a friend at an old castle in a little place on the Weser River, near Bremen, and looking through the library of that place discovered an old historical atlas, in which I found, among other interesting things, a map of Central and South Africa, which was particularly accurate concerning the Congo River, and the Lower and Middle Zambesi, and especially contained a careful sketch of the old Portuguese gold mines in these districts. This map is known in England. I published it in 1895, and it is here on the table. With the map, which I think was a work of the celebrated French geographer De L'Isle, and was published in the year 1705, was connected a description of the Zambesi district, especially of the Portuguese gold markets there. In this description I read the following passage, which seemed to me extremely remarkable, viz.:—

"Fifty lieues (one lieue is about two and one-third miles) from Tete, ten lieues from Bocuto, and half a day's journey from the River Mansoro, is the fort of Massapa, which used to be the principal gold market. It is to-day still the residence of a Portuguese captain, whom they call the Captain of the Gates, because from there onward in the country one finds the gold mines. The Dominicans have there a Church of Notre Dame du Rosaire."

It is, therefore, a place from which one may expect good and reliable information.

"Near this place is the great mountain of Fura, very rich in gold, and there are people who say that this name 'Fura' is a corruption of the name Ophir. One sees to-day still in this mountain (*dans cette montagne*) walls of cyclopean stones (*pierres de taille*) of the height of a man fixed together with an admirable art, without mortar and without being worked with a pick. It was apparently within these walls that the Jews of the navy of Solomon stayed. Since that time, the Moors have been masters of this ('Gold') commerce for several centuries. In this mountain the river of Dambarari goes to the north. These two markets were destroyed by the General Gamira, a Caffre, who rose in the month of November, 1693, with this difference that the inhabitants of Longoe, Portuguese as well as Canarins, had time to save themselves and escaped, but those of Dambarari, who wished to show themselves more courageous, all perished while defending themselves. So was it that all the gold-markets which the Portuguese had established in the Mocranga, during such a long space of years, were destroyed simultaneously, to avenge the injuries which they had inflicted on the Emperor of Monomotapa, who had always received them as their children; or as the Portuguese explain it themselves, because their wives showed a little too much friendship to the strangers."

In the same year, 1895, I read in Bent's book on "The Ruined Cities of Mashonaland" (p. 295) the following:—"Couto, the Portuguese writer, speaks of the gold-mines here (on the Mazoe, as Bent takes it) in his quaint legendary style: —The richest mines of all are those of Massapa, from which the Queen of Sheba took the greater part of the gold, which she went to offer to the Temple of Solomon, and it is Ophir, for the Kaffirs call it Fur, and the Moors Afur."

Since 1895, I have been following up this discovery and studying the question of this mysterious Fura district, and the whole Ophir literature in general. I published the first result of my researches in a book called "King Solomon's Golden Ophir," in which I set forth, that our modern name for Africa is nothing but the Latin adjective form of the ancient Semitic word "Ophir" or "Afer," as it was called in South Arabia.

At the same time I have located "Fura" or "Mount Fura," as it is generally known, on the principles of geographical criticism. According to the reports I had before me, Fura was to be looked for about half-way between Tete and Sena, near the southern bank of the Zambesi River, in the East of Lupata, opposite the Rufumbo Lake, in a district called in the old reports "Dambarari," which I soon identified with the "Tambara" of our days. In this district I found on the most modern maps a place called "Injakafura." This I had all reason to identify with the Fura of the old reports. Inja is the prefix for "place" in general, "ka" means in the native language "big" or "great," so Inja-ka-Fura is "Place of the great Fura," and I may as well mention here that Fura means in the language of Macombe's people, Makalanga, "Mine" or "Hole," and, therefore, has the same meaning, according to our most recent researches, as the ancient Semitic word "Ophir," or "Afer." Injakafura means "place of the great mine." In all our reports Fura was mentioned as the richest gold district known to the Portuguese. It, therefore, seemed to me, from a scientific as well as from a material point of view, advisable to go and explore this district on the spot. Now, Injakafura is a part of the country of the Chief Macombe, and in this fact you have in brief the basis for my expedition through Macombe's country.

That the gold mines of Fura, the knowledge of which had been lost since the end of the 17th century, had never been re-discovered til last year was owing to the fact that the Makalanga tribe, under their chief Macombe, had always been hostile to the Europeans, and did not allow any white men to enter their country.

War has been raging between them and the Portuguese for centuries. If you read Theal's book, "The Portuguese in South Africa," you will find the history of the relations between the Portuguese and the Makalanga tribe fo centuries back. It was a continual chang from peaceful understanding into mutiny and war, which ended in 1693, with the expulsion of the Portuguese invaders for good.

In April, 1899, I led my expedition abou 200 miles up the Zambesi River to the easter entrance of the Lupata Gorge. I had with me among others, Mr. Leonard Puzey, from Bulawayo, who had had a trading station nea Lupata Gorge two years previous, and knew the Makalanga language and the people—and Mr. Gramann, a mining engineer, of Germa education, who had worked for years on th Rand and in other gold districts of Sout Africa; and three other gentlemen besides.

The station, which formerly belonged to Mr Puzey, is Mitonda, and from here I decided t lead my caravan directly to the Injakafura c the modern maps. I will not in this plac describe in detail the history of our explorations in the Fura district. It may suffice t mention that we found the "Massapa," whic

is always mentioned in connection with the Fura mountains as lying east of them, on the second day we were on the spot.

Massapa is now generally known by the natives as "Injasapa," but also under the name of Massapa. This, I take it, is the corruption of the original name, "Massaba," just as the Sabi river in its upper part is called "Rusapi." We have in this name, therefore, a similar indication of a Sabæan conquest, as in the word Sabi in the south.

In the west of this place Massapa, a picturesque slate *massive* is arising, which is the eastern escarpment of the Fura district. Through this *massive* the Muira river bends its way in a northern direction. Like sentinels two bold table mountains lying on the right and left hand side of the river bed stand guard.

For years I had certain fantastical ideas about the appearance of Fura. This time for once the reality surpassed all fancies. A more picturesque and at the same time more mysterious place even the fancy of a Rider Haggard could not have depicted. Such is the entrance into the ancient fabulous Eldorado. Like two rock castles the black masses of slate stand on the left and right hand sides of the Muira river, overgrown on the flat tops by plenty of green. Below, the water of the river is rushing, in which the dark blue sky of the tropical world reflects itself. Into the river valley on both sides the dark rock walls fall down at the eastern side like hill waves, then further west steep and wide, and above this charming landscape the sinister silence of death.

This valley is about five miles long from south to north. There must have been a time when its southern entrance was closed and formed one *massive* through which the Muira river has broken its way. We found distinct traces of this at the southern entrance of the river into the mountain. South of this gorge the right-hand escarpment turns in a wide bending to the east, while that on the left hand turns to the west: thus they make a wide valley formed by a steep escarpment. Towards south-west the right-hand margin nears the southern continuation of the east. On the left-hand side it elevates itself in the Msusi Mountain once more into a steep and mighty slate rock. It, so to say, locks the valley in the south. Below this Msusi Mountain the great Kraal of Injakafura is situated, where the Induna of Macombe Kamboroto, Governor of the whole district of Injakafura, resides. This district runs about eight miles towards west and south. The greater part of it has formerly been a lake, and is now alluvial ground, in which we soon discovered alluvial gold. Above the Injakafura Kraal, opposite Mount Msusi, in the east of this alluvial plain, a hill rises, on which we discovered ancient ruins. These ruins are, without doubt, the remains of old fortifications, which must have commanded the plain towards west.

Permit me to give you a short description of these ruins. It seems that formerly there was an artificial ditch at the bottom of the hill, into which the Muira was led, as the river is deeper here than anywhere else, and runs directly round the bottom of the hill. It is possible that behind this ditch round the bottom of the hill was formerly a cyclopean wall, which is marked to-day by vast *débris*. Round the margin of the top we found the remnants of an old wall, the stones of which had apparently been worked with a pick, as they showed certain triangular forms, with the edge turned outside. On the centre of the hill we found a mighty horizontal ledge, which we first took to be the entrance of a cave. Later researches, however, proved that this was a mistake. Round this ledge a wall of artificial form had been built, but was now fallen to pieces down to the ground. Near this wall we found a great number of curiously formed stones, which I am inclined to take to be Betylæ. Betylæ formed the object of religious worship in the oldest Semitic cults. Among these Betylæ I found a regular phallus. The worship of the phallus was connected with the original Semitic sun worship. That these stones were worked by men, and not the play of nature, is proved by the fact that they are formed by sandstone, while the rock and the whole formation of the hill is crystalline slate.

In its middle the hill is surrounded by a big cyclopean wall about 30 feet below the top. This wall follows in a circle the outlines of the hill, some places standing up to 15 feet and higher, other places half broken down, and at other places broken down altogether. Here the stone stood bare, there it was overgrown by dense green. We therefore have in this ruin decidedly the general Semitic type. The wall in the middle of the hill is particularly characteristic. I am certain that careful excavations, which last year I had not time to carry out, but shall do so this year, will bring to light a great deal of remarkable evidence.

The place for this building was excellently

chosen. As a fortress it had command of the plain in front as well as the entrance to the Muira gorge. Opposite in the west a mountain range rises which is of dioritic formation, and is called by the natives "Injakalongoe." Through these mountains, about four miles west of Injakafura, a small tributary is winding, in which the natives still to-day wash gold after the rainy seasons. In former times when the whole plain was a lake it must have run into this lake at its north-western corner. The name of the river is "Injabanda" and on its banks we found mighty quartz reefs with ancient workings, in which, by panning, we soon tested gold. The old workings not only were surface workings, but also shafts, a road cut into the rock and an old quarry were there. I think that these gold mines correspond with the so-called Abyssinian mine of our reports. The more I think of this the more I am convinced of it, as the quarry is particularly mentioned in the Portuguese reports. It was worked by the Portuguese themselves shortly before they were driven out from Macombe's country altogether. The gold belt runs from this reef in a northerly direction towards the Zambesi river. The formation is always the same, slate is bordered by diorite in the west and in this diorite the quartz reefs are embedded between bars of slate again. The Injakalongoe range, which is called in its northern continuation "Injandara," and runs parallel to the Fura escarpment, represents the dioritic counterpart of the phyllitic slate of Fura. Geologists will agree with me when I say that these rocks represent a distinct gold formation. Several of the gold reefs also in the north near the Zambesi river have formerly been worked

If you allow me to put my discoveries about the Fura mines together, the picture is as follows:—The Injabanda river, in former times, ended in a lake, the centre of which was about where the great Kraal "Injakafura" is situated. Through this Injabanda river for millions of years alluvial gold has been carried into this lake, and when the Muira broke its way through the eastern escarpment, a great alluvial plain was laid dry, in which the conquistadores thousands of years ago must have worked alluvial gold. They built a fortification on the eastern borders of this alluvial plain. Whether it will pay to work this plain for alluvial gold with modern machinery I intend to examine next summer. I should say if we go deeper with dredging machinery we may find the bed rock rich in deposits, and payable. Anyhow, the reefs from which this alluvial gold has been washed down from Injakalongoe towards the Zambesi river are mighty, and according to all surface indications of splendid quality. They are all full of iron pyrites, and we have proved gold in the pan and by chemical analysis. They are very broad, up to 30 feet, and the gold is finely distributed in the quartz, as in the banket formation of the Rand. They have been tested by old workings, and I am convinced that they at least equal most of the payable gold mines of South Africa of our days.

We have two great points which add to my conviction. The one is the neighbourhood of the navigable Zambesi river, on which regular steam navigation is going on already up to Tete; the second fact is the abundance of timber and fuel. This whole northern part of Macombe's country is one great forest, in which the settlements of the natives are dispersed. Acacia and Mapani trees, the best known mining timber in Africa, are abundant. We have simply to cut it near our mines, and, I may mention that coal also is very near these gold districts, as a little higher up towards north-west the so-called Tete coal formation commences, which is now already worked north of the Zambesi. Besides these favourable circumstances we have cheap and plentiful labour in the country. Macombe's people nowadays go to Umtali and Macequece to work, but they have declared they would much rather remain in their own country if mining would commence, as in the south. I think it would not be difficult to make arrangements with Macombe for a continual supply. I shall arrange all this as soon as I return to Fura, and shall soon be in a position to lay definite facts before the public.

At this moment it may suffice to state in general that Fura is one of those districts from which labour now is supplied for the southern mining centres.

When I had finished these explorations in three months' work, I built a station, left two gentlemen, one of whom was a mining engineer, in charge, for following up our discoveries, and with another mining engineer, Mr. Gramann, marched south-west in order to pay a visit to the great Chief Macombe and explore his whole country from one end to the other. I marched alongside the Muira river as far as "Misongwe," the residence or as they call it in the country "Simbabwe" of Macombe. Macombe is not a name but a title, and I can prove that Monomotapa of the 16th century was then already identic

with the dynasty of Macombe. That the residence of the Monomotapa was near the Injakafura district and not further west in Mashonaland and Matabeleland is clearly proved by all Portuguese reports.

In 1569, King Sebastiao sent out Francesco Barretto with a large expedition to East Africa, in order to conquer the gold mines in the Makalanga country. Barretto went up the Zambesi river as far as Sena, and from there he sent ambassadors to the Chief of the Makalanga, in order to arrange a contract. If the Mazoe and a district in Mashonaland had been in question, Barretto would certainly not have gone to Sena, but at least up to Tete, and negotiated from there. Sena was situated on the eastern borders of Monomotapa, as it is situated to-day on the eastern borders of the country of Macombe. The Portuguese then made a contract with the Makalanga, in order to beat the Mongasi or Monge, a tribe which lived north of the Makalanga, on the borders of the Zambesi, between Tete and Sena. There is not the least doubt that this name has been preserved in the "Injamongali" of to-day, in whose district the northern gold reefs we discovered are situated, and where I built a station at Tenje. "Mongali" is the adjective form of "Monge."

From Sena, Barretto went up river and apparently took the same road which I took last summer to Injakafura and Injamongali. This expedition, as I may mention, failed from illness and want of food. Barretto died.

In the following year, Vasgo Homem tried to reach the Makalanga empire from Sofala. Can it be imagined that he would have started from Sofala if a district near the Mazoé River was aimed at? Will you please kindly look at the map in order to form your own opinion on this point. I mention these facts because there is a dispute about the situation of the Monomotapa empire up to this day. The book I am about to publish on the subject will enable me to put all my evidence before the public.

Into the centre of this old country I marched about the middle of July last year, and arrived at Misongwe on the 18th July. Misongwe is a place of about 5,000 to 6,000 inhabitants, and, from a native point of view, rather strongly fortified. It is about 1,200 feet above the level of the sea.

Makalanga means "people of the great sun," "Ilanga" being the name for sun. The tribe belongs principally to the Bantu race of Central East Africa, but they have a strong Asiatic influx of blood, more than any other nation which I know in Africa. The constitution is a despotism, but mitigated by a patriarchic relation between the chief and people. All soil belongs to the Macombe, who hands it over to the individuals for working it. Altogether Macombe seems to have the right to all property in the country, but I do not exactly know how far this right is enforced. It seems, in weddings, the female side has a sort of co-decision; divorces are frequent. The man does not exactly pay for the girl, but he gives the father of the bride a present in goats. Ten goats for a pretty girl is considered a rather high figure.

All the Makalanga are soldiers; conscription is the fashion. Macombe has about 7,000 rifles. Besides these, arrows and assegais are still used.

Among the occupations, mining has the first rank. Gold is washed in the rivers, and sold in quills. Iron is dug in holes, and is melted in furnaces. It is won as well from oxidised quartz as from iron-stone. The Makalanga are very clever blacksmiths, and their knives are much sought after for bartering articles. They also fabricate picks and hatchets. Besides this, they are very smart carpenters. Wood-carving is highly developed in their country. Further, their mats also show great cleverness and taste. The women all over the country fabricate earthenware goods, such as buckets, pots, and tumblers. Great they are in brewing beer. From June, when the harvest is ripe, happiness and dancing goes on all over the villages. More than anything else, this part of their national life gives the Makalanga boys in Umtali and Macequece homesickness, and induces them to desertion.

Circumcision was formerly common, but is now abandoned. The dead are buried in a lying position in graves. The souls of the dead, the "Mazimos," are honoured by drink and food sacrifices. Very interesting are the religious ideas of this tribe. The Makalanga believe in the great God "Mlungu," who lives in the blue sky. Besides him, there is a god who lives on or in the earth, who is worshipped. That is "Kabulu Kagoro." He owns all the fires in the land, and his service is done by the high priestess of this tribe, an old woman, who has the title of "Quara Quate." She sees him, speaks to him, and reports his orders to Macombe. She also gives him sacrifices, which are called "juswisse." These sacrifices consist of meat and grain.

Every year a big sacrifice by the whole clan takes place, near the grave-yard of the chiefs. Then all the fires in the country must be extinguished, as they have grown dirty by the use of a year. Quara Quate then hands over to Macombe the sacred fire, which she keeps all the year in the house of Kabulu Kagoro. Macombe hands this over to his people, and all the fires have to be re-lighted from it. You will agree with me that this is a very interesting point, which shows some likeness to the Parsee worship and certain ancient Semitic worships. I have not found anything of this sort in any other African country.

The type of the people is not so much Arab, as distinctly Jewish. The men are particularly strong and big in stature, generally Bantu forms. Then you meet again with small types, with very fine clever expressions. The girls are prettier than most Bantu girls, and remind one a little of European ladies. They are rather graceful and not at all bashful in their intercourse with strangers, quite different from the submissive behaviour of ordinary nigger girls. When they hand you anything over, they take it into both hands and bow deeply. When they salute you they lay their hands above the bosom and make two or three curtsies. The men also curtsey when they salute you. Apparently they have learned this from the Portuguese. If a Makalanga passes your tent or house, he takes off his cap till he is out of sight. The manners of this clan, at least of Misongwe, seem to be rather loose. Beer is much drunk, and dancing seems to go on daily. The abundance of babies is remarkable. The whole race are agriculturists. Millet, maize, ground nuts, sweet potatoes, and tobacco are grown everywhere.

Macombe is held in religious awe, and it was interesting to me that he as well as Cuntete, who accompanied me to London, always protested they did not belong to the Makalanga tribe, but were of other divine origin. Whether the family is of Asiatic origin, I could not state. All the princes of the house have the title "Injakafura."

I stayed in Misongwe about a week, and succeeded in entirely making friendship with Macombe. Macombe is a man of about 48 years of age. When we entered the place, we were not exactly delighted to see two skulls of whites on poles over the entrance door, but we succeeded soon in winning the friendship of the Chief, which is of a very great importance for our further work in the country.

Macombe's country is situated in the Portuguese sphere of interest, but up to this time it is practically independent. I hope the Portuguese will be able to settle with Macombe, and I shall be pleased to help them in these endeavours. Macombe is well aware that he has to settle somehow or other with the whites, who he sees advancing in all directions, building railways near his dominion, and whom he knows he cannot resist for ever. I think that was the main reason of making him inclined to arrange with me. I have made brotherhood with him, and he gave me his favourite brother Cuntete as companion through the rest of his country, and even as far as London. He also gave me the right of starting a store in his country, and I think that this is well worth having, as he is rich in gold, ivory, wax, and india-rubber, and a well-managed store is sure to pay.

Altogether I think this part of Africa, from an industrial point of view, must have a future. The advantage of the navigable Zambesi leading to it cannot be valued highly enough. When the Mashonaland railway has been finished as far as Tete, you will soon perceive that as the Zambesi trade turns towards Mashonaland, the trade of Mashonaland will turn towards the Zambesi, and seek an outlet at the Indian ocean.

The country of Macombe is well adapted for plantations along the Zambesi. The sugar-cane grows abundantly on the banks of the Zambesi, and I think that fine tobacco may be grown all over the country. At the western side of the country, we discovered a mountain range called Baraouro, which rises up to 4,000 feet, and is well watered. Here tea cocoa, coffee, and other cultivations may be started, and in this part European settlers will find a healthy climate. The south of the country towards the Pungwe is again a big forest, full of game, an Eldorado for the hunter.

I will not here enter on the question whether we have in the Fura district, the real spot of the ancient Ophir, as this question is only indirectly connected with the natural wealth of Macombe's country. I personally have reasons which I will bring forward, that King Solomon's gold expeditions were directed to this part of the world. On the Zambesi, Solomon's people could find all the goods, which are mentioned in the Bible as freight of the Ophir ships—gold, ivory, gum-trees, and guinea fowls, as well as apes. Up to the Fura district was a continual water connection from the Red Sea. Merchants could sail up the

river as far as the Lupata Gorge, and it is quite likely that they heard from the natives at the mouth of the Zambesi of the existence of this alluvial district. The likeness of the names, Fura and Afer, is perhaps not decisive, but still very remarkable. So also is the fact that Fura to-day has the same meaning in the Makalanga language as Ophir had in the ancient Semitic languages, "hole" or "mine." The existence of ancient Semitic ruins, as well as the survival of the old Semitic religious ideas in the population are also remarkable.

What I am inclined to consider a strong evidence in favour of my Ophir theory, is the fact that when the Portuguese arrived in South Africa Arab traders told them that up the Zambesi river was the gold land of Afur, our Fura of to-day, and this was identical with King Solomon's Ophir. Now the Arabs were the natural decendants of the ancient Sabæan conquistadores, and a continuity of tradition from the ages of their ancestors on this point is not at all surprising. I think critical scholars will agree with me that this is, indeed, a very strong argument.

Still, I will not enter more fully on this subject here to-night. The country I have explored last summer is not situated in the moon, but in shipping communication with Europe, und plenty of other people will go and see it, and look after these questions. So it is no use disputing now, as the exploration has only commenced. What I want to state here, and what I hope I have proved to-night, is that this country has a future of its own, and that its opening up must prove of advantage to the development of trade and civilisation in South Africa. When mining commences, and new fields for export are created, when the natives by the honest work we will give them earn more pay than now, and are therefore enabled to buy goods from Europe, then trade must be developed rapidly. Plenty of new goods for export will be created for the European markets, and the buying strength of the country must also be hereby increased. Roads will be built from the navigable Zambesi into the country, modern waggons, and, in time to come, railways will open up the district more thoroughly. Then Macombe's country will be one of the districts of the world's commerce. This outlook will encourage me and my friends in our further work, and if we succeed in achieving what we aim at, we shall be always conscious that we are working, not only for material gain, but also in the interest of that European civilisation which is sure to conquer the whole planet sooner or later.

In Macombe's country and in my last work, I have always been conscious that on a small scale I was labouring under the shadow of the great name of David Livingstone, who first explored and opened the Zambesi high road, and turned the attention of Europe in this direction.

Thankfully I acknowledge what your great countryman has done, and when we succeed in running our own steamers on the Zambesi, I hope that the first of them will be named David Livingstone.

DISCUSSION.

The CHAIRMAN said while public attention was entirely centred on South Africa, and the war going on there, Dr. Peters had taken them a trek up north to the Zambesi, and given them a most interesting and instructive paper. He had pointed out in a convincing manner that our modern name of Africa was practically the Latin adjective form of the ancient Semitic word "Ophir," or Afer as it was termed in South Arabia, and had shown that the links between Asia and parts of Equatorial Africa were numerous in ancient times. It seemed also to him (the Chairman) that the few specimens of the Macombe language, as given by Dr. Peters, had a certain resemblance both to Arabic and Hebrew, and this bore out a growing opinion rendered highly probable by the accurate researches of M. D'Anville and Mr. Bruce that the ancient fleets of King Solomon after passing the Straits of Bab-el-Mandeb did not sail on to Ceylon or India, as many had hitherto thought, but held their course along the south-east coast of Africa, as far as the Zambesi and the kingdom of Sofala, whence they drew their rich stores of gold and silver. It seemed to be probable also, as suggested by Dr. Peters, that from these same localities the Queen of Sheba collected those quantities of precious metals and stones which she presented in such abundance to King Solomon. He should be glad if Dr. Peters could tell them what sort of machinery would be required in these new goldfields; would hydraulic machinery, such as was used in California be available, or would quartz-crushing machinery be wanted. No country, in his opinion, could be really great, unless white people could live there, and he should like to know whether the climate generally of Macombe's country would be suitable to Europeans. It appeared that there were certain elevated portions which were very healthy, but he should like to know whether the country generally was suitable for European colonisation. Certainly, so far as could be judged from the clear and graphic paper which Dr. Peters had read, the country which he had explored with so much

success seemed to have a promising future in the development of trade and civilisation in that part of the world, aided by so good an outlet as the Zambesi river. At the close of his paper Dr. Peters had rendered a fitting tribute to our great countryman, David Livingstone, and in response to his cordial reference he was sure that the meeting gave the reader of the paper a hearty welcome, as one who belonged to the great German nation, with whom we all desired to be on terms of amity and friendship.

Dr. GOODSALL asked what was the extent of the alluvial plain, the nature of the loam, and its depth; also if there were any diamonds there.

Prof. C. LE NEVE FOSTER, F.R.S., said this paper was an excellent illustration of the re-discovery of ancient gold mines by four well-known indications—by the use of old records, by identification of names of old places, and by the presence of ruins. Many features might be found in these old diggings reminding one of similar things in this country. Injakafura meant a great mine, and in Cornwall you had the name Wheal Vor, with the same meaning. There was also a similar connection with the Jews, for in Cornwall the old tin smelters were Jews, or at all events the remains of their old workings were known as Jews' houses to this day. There was also a survival of fire worship in the west of Cornwall, and he had had to have the bon-fires or fires cleared away from the road at Midsummer in order to allow a carriage to pass. Again with regard to the use of quills, the old tin-streamers who got a small quantity of gold in their operations used to put it into quills. With regard to Dr. Peters' difficulty in seeing how Fura could be in Mashonaland, he would suggest that there might be more than one Fura. They knew the word meant a mine, and they also knew that there were gold mines in Mashonaland; why should there not have been two Furas and two Monomotapas, or mining chiefs. They used the word Zimbabwe in Macombe's country, and they had the same word in Mashonaland. He failed to see how the Makalanga, however clever they were, could extract iron from "oxidised quartz" in any appreciable quantity; and with regard to the gold in the quartz in Macombe's country being distributed in the same manner as it was in the banket reefs in the Transvaal, he would point out that in the latter district the gold was not in the quartz or in very small quantity; the banket reefs were a sort of pudding stone and the quartz pebbles corresponded to the plums; the gold was found in the cementing material, mainly pyrites, which held the pebbles together. These were only trifling criticisms, and he rejoiced immensely at this rediscovery of these old goldfields which he hoped would prove very prosperous.

Mr. A. R. SAWYER said he had found the banket formation in Macequece very similar to that of the Rand, and he advised its being prospected for gold; he thought it quite likely from the description of th rocks which Dr. Peter's had given, that there migh be some banket found there. The great advantag of this place was that it was close to the Zambesi, an as there was coal at Tete, with plenty of timber, an cheap labour, the gold industry ought to flourish.

Mr. ST. CHAD BOSCAWEN said this paper w extremely interesting to him as another link in co nection with the work carried out by the late M Theodore Bent, with whom he worked a good de on the material he had collected. He had alwa taken an interest in the subject of mining in tho regions, and in 1893, when in Egypt, he visit all the mines and quarries he possibly coul both in Egypt and in the Sinaitic peninsula. all those quarries you found sculptured, eith over them, or in the immediate neighbourhood, t figure of a hawk, and, as they were aware, simi figures were found by Mr. Bent in Mashonalan When he read Dr. Peters's book he thought he h made out a very good case from very sm materials, but he seemed to have consideral strengthened it. When the eastern side of Afr was explored as far as Suakim, he believed traces mines would be found in all the hills. Mr. Bent, his last book, referred to some he had found at t back of Massowah and Suakim, which were protect by circular forts, similar to those in Mashonala It seemed as if the great miners of antiquity w the people from the Sinaitic peninsula and West Arabia. When the dynastic Egyptians came in the great road through the middle Nile Valley, t brought with them the worship of Hathor the godd of mining, and associated with her was always fo the god Supt, who was always attended by hawk. He should like to know if Dr. Pet had found any representations of those bi in the old mines he had visited. He hoped t before he returned to his work he would al archæologists to give him a few hints what to l for; for instance these birds. Another important po which had been worked out by Mr. Swan, was orientation; in Mashonaland it was very simila what it was in Egypt, the entrance generally be to the west.

Dr. PETERS, in reply, said when he poi out that the distribution of the gold in the qu was similar to that in the banket, he was q ing Mr. Gramann, and what he meant was tha was generally invisible, and was only to be obta by crushing. Next summer they would follow the reefs, sink shafts, and make a more thor examination; hitherto the prospecting had only carried on so far as to indicate the presenc gold, but not to show the richness of the posit. He had not found any bird symbols in old ruins, but he had found several things w were generally associated with the hawk, and he not give up the hope that in going deeper int

débris they would be found. He believed these ruins were the oldest in South Africa, and that time had effected more destruction there than at Simbabwe, and he had only a week to examine them. Professor Foster was quite right in supposing that there were several Furas; but the question with him was to find the classical Fura referred to in the Portuguese reports, to which Barretto went, and for the reasons stated in the paper, he knew he had identified it. The alluvial valley was about twenty square miles, but he did not think there were any diamonds in that particular spot. There might be some to the north-west. He had always had a great admiration for Solomon and the Queen of Sheba but he was rather annoyed to see how much gold they had taken away without, as far as he knew, having had any concession. The climate on the middle Zambesi was that of a moderate tropical zone, in his opinion an agreeable one; but it would require good building accommodation to be quite healthy; while on the highlands, in the west, the most delightful climate in the world prevailed.

The CHAIRMAN then proposed a hearty vote of thanks to Dr. Peter's, which was carried unanimously, and the meeting adjourned.

Miscellaneous.

NEW FIREPROOF MATERIAL IN GERMANY.

The United States Consul at Freiburg calls attention, in a recent report to his Government, to a new industry which has lately been introduced into that city, and which promises to be a great commercial success. The business pertains to the treatment of cottons, linens, woollen goods, &c., or any article of fibrous or textile nature, by a chemical process which renders such articles fireproof. By the new method, the goods that are to be rendered fireproof are treated chemically by a very quick process which does not act on the fibre, so the goods lose nothing in strength, nor does the treatment in any way affect the colour or perceptibly increase the weight, and the advance in the price of the article is very slight. Consul Liefeld states that he procured some samples, and tried a few experiments with cloth which had been made fireproof by the new process, and found that no flame was produced, as was the case with similar articles which had not been so treated. Only where the candle flame came into direct contact with the cloth was the fibre charred, but there was no spread of fire, and as soon as the flame was removed the charring ceased. He poured some kerosene oil on a piece of the cloth and ignited it; the oil burned vigorously, but the cloth was simply charred where it had been soaked with oil, and there was no spread of fire. A piece of wood wrapped in a piece of fireproof canvas was placed for a few moments on the red-hot anthracite coals of a furnace, and when examined was found to be uninjured, except where it had been in direct contact with the coal. It would seem from these experiments that such a fireproof article would be serviceable for the storing or packing of explosives. There is one disadvantage connected with this discovery which prevents the use of these fireproof articles for out-door purposes, viz., that water can dissolve the chemicals, and then the substance is no longer fireproof; but, as such material can be washed, and then re-impregnated very easily and cheaply, and so again rendered incombustible, it would seem that this does not greatly depreciate its value. Steam and moisture do not affect the fireproof qualities, nor does the application of heat. It is also claimed that the manufactured article is not in the least poisonous. It is stated that the increase in price to the consumer of the fireproof article need not be more than three-halfpence the square yard over that of the unimpregnated, and in large quantities the difference would be even less, while the increase in weight would be only about one pound for every 50 square yards of material.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MARCH 14.—"Continuation School Work in Rural Districts." By H. MACAN, M.A., F.C.S. The RIGHT HON. SIR WILLIAM HART DYKE, M.P., will preside.

MARCH 21.—"The Use and Abuse of Food Preservatives." By DR. SAMUEL RIDEAL. OTTO HEHNER, F.I.C., F.C.S., will preside.

MARCH 28.—"Leather for Bookbinding." By DOUGLAS COCKERELL.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Manufacture and Use of Indigo." By CHRISTOPHER RAWSON, F.I.C. SIR WILLIAM BRERETON HUDSON, K.C.I.E., will preside.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

[The meeting of May 17 will be held at the Imperial Institute.]

FOREIGN AND COLONIAL SECTION.

At 4.30 o'clock :—

APRIL 2 (Monday). — "The Century in our Colonies." By the Right Hon. SIR CHARLES WENTWORTH DILKE, Bart., M.P. The Right Hon. LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., LL.D., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock :—

MARCH 13.—"English Furniture." By LASENBY LIBERTY.

APRIL 3.— "Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

APRIL 24.—"The Practice of Lettering." By EDWARD F. STRANGE. SIR WILLIAM ABNEY, K.C.B., F.R.S., will preside.

MAY 8.—"Art Metal Work." By NELSON DAWSON.

CANTOR LECTURES.

Monday evenings at 8 o'clock :—

E. SANGER SHEPHERD, "Photography of Colour." Four Lectures.

LECTURE II.—MARCH 12.

The Representation of a Coloured Object in a Monochrome Print. — Definition of the problem—Impossibility of representing colour contrasts in monochrome—The representation of colour according to luminosity—The preparation of a test object—Colour sensitive plates—Light filters—Progressive orthochromatism.

LECTURE III.—MARCH 19.

The Representation of a Coloured Object in its Natural Colours.—White light—Young's theory of trichromatic vision — Spectrum colours and colour mixtures—Processes based upon Young's theory—Light filters for trichromatic photography — The negative—The preparation of transparent prints in natural colours for the optical lantern.

LECTURE IV.—MARCH 26.

The Application of the Trichromatic Method of Colour Photography to the Printing Press.—Light filters—Suitable plates and negatives—Preparation of the printing surfaces—The half-tone process, its faults and difficulties—Inks—The printing of the three impressions—Colour-printing machinery.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. E. Sanger Shepherd, "Photography of Colour." (Lecture II.)

Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 7½ p.m. (Graduates' Meeting.) Mr. Brees Van Homan, "Steel Skeleton Construction, as applied to Buildings on the American System."

Imperial Institute, South Kensington, 8½ p.m. Mr. C. T. Gardner, "China."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. J. Shiress Will, "Underground Water."

Sanitary Inst., 74A, Margaret-street, W., 8 p.m. Mr. W. C. Tyndale, "House Drainage."

Camera Club, Charing-cross-road, W.C., 8½ p.m.

Medical, 11, Chandos-street, W., 8 p.m.

TUESDAY, MARCH 13...SOCIETY OF ARTS, John-stree[t] Adelphi, W.C., 8 p.m. (Applied Art Section) Mr. Lasenby Liberty, "English Furniture."

Royal Institution, Albemarle-street, W., 3 p.[m.] Prof. E. Ray Lankester, "The Structure a[nd] Classification of Fishes." (Lecture IX.)

Childhood Society, 72, Margaret-street, W., 8 p.[m.] Dr. G. E. Shuttleworth, "The Training of Defe[c]tive Children under School Boards."

Medical and Chirurgical, 20, Hanover-square, W[.,] 8½ p.m.

Civil Engineers, 25, Great George-street, S.W. [8] p.m. Sir Charles Hartley, "A Short Hist[ory] of the Engineering Works of the Suez Canal."

Photographic, 12, Hanover-square, W., 8 p[.m.] Mr. E. Howard Farmer, "The Illumination [of] Developing Rooms."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall-rooms, Whitehall-place, S.[W.,] 8 p.m. Dr. P. Manson, "A School of Trop[ical] Medicine."

Asiatic, 22, Albemarle-street, W. 3 p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p[.m.]

WEDNESDAY, MARCH 14...SOCIETY OF ARTS, John-st[reet,] Adelphi, W.C., 8 p.m. Mr. H. Macan, "C[on]tinuation School Work in Rural Districts."

Sanitary Inst., 74A, Margaret-street, W., 8 p[.m.] Dr. F. Clowes, "Experimental Bacterial Tr[eat]ment of the London Sewage."

Japan Society, 20, Hanover-square, W., 8½ p[.m.] Mr. Arthur Diósy, "Glimpses of Japan."

THURSDAY, MARCH 15...Royal, Burlington-house, W., 4½ [p.m.]

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr[.] Botting Hemsley, "Report on the Bota[nical] Results of an Expedition to the Mount Ror[aima] in British Guiana, undertaken by Messrs. [F. V.] McConnell and J. J. Quelch." 2. Mr. A[.] Waters, "Bryozoa from Franz Josef [Land,] collected by the Jackson-Harmsworth Exped[ition,] 1896-97."

Chemical, Burlington-house, W., 8½ p.m. 1[.] Brereton Baker, "The Vapour Densities of [...] Mercury and Mercurous Chloride." 2. Dr. A. [...] "The Preparation of pure Hydrobromic A[cid.]" 3. Dr. A. Scott, "A New Sulphide of Ars[enic.]" 4. Mr. R. L. Taylor, "The Action of Iodi[ne on] Alkalies." 5. Drs. Edward Divers and Tam[emasa] Haga, "The Interaction between Sulphit[es and] Nitrites." 6. Messrs. Julian L. Baker and T[.] H. Pope, "New Polysaccharides: Manna-ga[lactan] and Lævulo-mannan."

Royal Institution, Albemarle-street, W., [...] Dr. C. Waldstein, "Recent Excavations [...] Argive Heræum, in Greece." (Lecture III.)

Historical, St. Martin's Town-hall, Charing-[cross-]road, W.C., 8½ p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

Camera Club, Charing-cross-road, W.C., 8[...]

FRIDAY, MARCH 16...Royal Institution, Albemarle-stre[et,] 8 p.m. Weekly Meeting. 9 p.m. Sir B[...] Stone, "Pictorial and Historical Records."

Sanitary Institute, 74A, Margaret-street, W. [...] Mr. C. Jones, "Scavenging and Disposal o[f] Refuse."

Quekett Microscopical Club, 20, Hanover [...] W.C., 8 p.m.

SATURDAY, MARCH 17...Royal Institution, Albemarl[e-street,] W., 3 p.m. Lord Rayleigh, "Polarized [...]" (Lecture II.)

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FRIDAY, MARCH 16, 1900.

'll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 12th inst., Mr. E. ANGER SHEPHERD delivered the second lec- ıre of his course on "Photography of Colour." The lectures will be published in the *ournal* during the summer recess.

APPLIED ART SECTION.

Tuesday, March 13, 1900; SIR GEORGE IRDWOOD, K.C.I.E., C.S.I., in the chair. he paper read was on "English Furniture." y LASENBY LIBERTY, J.P.

The paper and report of the discussion will : published in the next number of the *ournal.*

THE ALBERT MEDAL.

The Council will proceed to consider the vard of the Albert Medal for 1900 early in ay next, and they, therefore, invite members the Society to forward to the Secretary, on before the 7th of April, the names of such :n of high distinction as they may think rthy of this honour. The medal was struck reward "distinguished merit in promoting ts, Manufactures, or Commerce," and has en awarded as follows in previous years :—

[n 1864, to Sir Rowland Hill, K.C.B., F.R.S., or his great services to Arts, Manufactures, and mmerce, in the creation of the penny postage, and his other reforms in the postal system of this ıntry, the benefits of which have, however, not :n confined to this country, but have extended over civilised world."

n 1865, to his Imperial Majesty, Napoleon III., or distinguished merit in promoting, in many ways, his personal exertions, the international progress Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvement in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (now Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of the several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world."

In 1885, to Mr. (afterwards Sir) Henry Doulton, "in recognition of the impulse given by him to the pro duction of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (now Lor Masham), "for the services he has rendered to th textile industries, especially by the substitution o mechanical wool combing for hand combing, and b the introduction and development of a new industr —the utilisation of waste silk."

In 1887, to HER MAJESTY THE QUEEN, "in com memoration of the progress of Arts, Manufacture and Commerce throughout the Empire during th fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholt For. Memb.R.S., "in recognition of the value o his researches in various branches of science and o their practical results upon music, painting, and th useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for h achievements in promoting the Arts, Manufacture and Commerce, through the world-wide influenc which his researches and writings have had upon th progress of the science and practice of metallurgy."

In 1890, to William Henry Perkin, F.R.S., "fo his discovery of the method of obtaining colourin matter from coal tar, a discovery which led to th establishment of a new and important industry, an to the utilisation of large quantities of a previousl worthless material."

In 1891, to Sir Frederick Abel, Bart., K.C.B D.C.L., D.Sc., F.R.S., "in recognition of the manne in which he has promoted several important classe of the Arts and Manufactures, by the application o Chemical Science, and especially by his researche in the manufacture of iron and of steel; and also i acknowledgment of the great services he has rendere to the State in the provision of improved war materia and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognitio of the merits of his numerous and valuable invention especially his improvements in telegraphy, in tele phony, and in electric lighting, and for his discover of a means of reproducing vocal sounds by the phono graph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S and Sir Henry Gilbert, Ph.D., F.R.S., "for the joint services to scientific agriculture, and notably fo the researches which, throughout a period of fift years, have been carried on by them at the Exper mental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S "for the discovery and establishment of the antisept method of treating wounds and injuries by which no only has the art of surgery being generally promote and human life saved in all parts of the world, bu extensive industries have been created for the supp of materials required for carrying the treatment int effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S "in recognition of the services he has rendered t Arts, Manufactures, and Commerce by his meta

ırgical researches and the resulting development of ıe iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., in recognition of the services he has rendered to ırts, Manufactures, and Commerce, by his numerous ıventions in electricity and magnetism, especially ıe printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for ıe services he has rendered to the United Kingdom y affording to engineers engaged in the water ıpply and the sewage of towns a trustworthy basis ır their work, by establishing and carrying on uring nearly forty years systematic observations ıow at over 3,000 stations) of the rainfall of the ritish Isles, and by recording, tabulating, and raphically indicating the results of these observa-ons in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, [.D., For. Memb. R.S., "in recognition of his ımerous and most valuable applications of Chemistry ıd Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for s extensive and laborious researches in chemistry ıd in physics; researches which have, in many in-ances, developed into useful practical applications in e arts and manufactures."

Proceedings of the Society.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 14, 1900; the Right Hon. r WILLIAM HART DYKE, Bart., M.P., in the ıair.

The following candidates were proposed for ection as members of the Society :—

shworth, Captain P., R.E., Akola, Berar, India.
eas, James, Municipal Offices, Warrington.
ammond, John Hays, 43, Threadneedle-street, E.C.
edderwick, James David, J.P., 2, Clairmont-gardens, Glasgow.
orrison, Gabriel James, 16, The Bund, Shanghai, China.

The following candidates were balloted for d duly elected members of the Society :—

den, Edward Goulden, North-street, Romford, Essex.
ck, George Handasyde, 31, Hamilton-drive, Hill-ıead, Glasgow.
nn, J., Brunswick-house, Cambridge.
tt, Romesh Chunder, C.I.E., 54, Parliament-street, S.W.
over, William, 16, Market-street, Newcastle-on-Tyne.
ta, Jamsetjee N., Victoria-building, Fort, Bombay, India.
agstaff, Edward Wynter, 3, Fytche-road, Rangoon, Burma.

The paper read was—

CONTINUATION SCHOOL WORK IN RURAL DISTRICTS.

By H. MACAN, M.A., F.C.S.

The proceedings of the Agricultural Education Committee, over which Sir W. Hart Dyke presides, and to which I have the pleasure to belong, have within the last six months directed public attention to the comparatively insignificant rate of educational progress in the past ten years in the rural districts as compared with the rapid strides taken in the large towns. Persons familiar with the facts are aware that owing to the operation of the Technical Instruction and Local Taxation Acts, the provision for instruction in subjects pertaining to trades, and open to the intelligent artisan in our large cities and even in the smaller urban districts, is little, if at all, behind that to be found on the Continent. In London the Polytechnics alone, to take an instance, have shown at the recent Educational Exhibition that they can produce work which would be considered quite first rate in any country in Europe. At the same time, by the use of their magnificent buildings and by drawing upon the rates, the large School Boards, such as those of Manchester, Birmingham, and Leeds, have carried out a complete scheme of work preparatory to that of the technical colleges or institutes, and have laid that sound foundation of mathematics, science, and art upon which all specialised industrial training must rest. But the rural districts have no buildings, and their School Boards exist to keep down the rates, not to spend them on improved education. Whatever aids to higher education there are in the towns it may safely be said are absent in the country. Yet who will contend that the need is not as great or greater. The lower standard of day school work, with the restrictions necessarily placed upon regular attendance by long distances or severe weather, raise the Continuation School into an even greater importance in the country. The want of occupation for the long winter evenings, and for many of the winter days, the absence of places of intellectual resort, such as libraries, or even recreative institutes, still further enforce the necessity for encouraging Continuation Schools and Classes.

The agricultural clause of the Robson Act, if brought seriously into operation, will force the continuation work into the position of an

absolute necessity for rural education. By this clause agricultural children, between the ages of 11 and 13, will only attend the day school in the winter months, and thus will probably be absent in the day time from May till October during those years. When one remembers that at 11 such children have probably only passed Standard IV., the difficulty on the one hand of connecting their future school *half-years*, and on the other of supplementing the necessarily meagre work of these half-years will be apparent. But I believe that even this seeming difficulty can be made to work out for good on the whole if the proper Continuation School measures be taken; these I will refer to later.

I propose to deal with the question under three headings:—

I. What has been done.
II. How has it been done.
III. What still remains to be done.

I. In the good old days, beginning at about 1840 and ending in 1890, there were practically no Continuation Schools in rural districts. The night schools dealt in elementary subjects almost entirely, and were either "dunce" schools or places of instruction for older persons who had never been at a day school. Elementary subjects were compulsory in them, and for part of the time they had to be connected with day schools, yet day school teachers (the only persons generally available) were forbidden to teach in them; age limits also hampered their development. The Royal Commission of 1888 recommended sweeping alterations; the principal of these were that "the elementary subjects restriction should be abolished," "that the subjects should be suitable to the needs of the locality," and "that there should be no superior limit of age." The Commissioners hoped that, thus, these schools should be places for "maintaining and continuing that education already received in the day-school." The Education Code Act of 1890, and the New Evening School Code of 1893, brought about most of those reforms. Since that date, as Mr. Sadler has it, "the work has become secondary rather than elementary in character." Meanwhile, the Technical Instruction and Local Taxation Acts had been passed, and the Code of 1893 was practically a recognition of the facts that in rural districts, on the one hand, the encouragement to these schools must come from County Councils, and, on the other, that these Councils must make the Continuation Schools the foundation of all their evening work.

A few figures will show the progress of th schools since that date:—In the Sessior 1892-93, there were 1,977 school departments with 115,582 scholars, of which 6,617 wer over 21 years of age.

In the Session, 1897-98, there were 5,53 school departments, with 435,600 scholars, (which 47,110 were over 21 years.

Thus, the schools have increased nearly thre times, the scholars nearly four times, and th pupils over 21 more than seven times. C course, a very large part of this increase ha been in London and other large towns, but th country districts have not been behindhan The statistics for 1892-93 are, unfortunately, n available in the shape required, but if we com pare the administrative counties (excludin London, Middlesex, Lancashire, and the We Riding, where the Continuation Schools a mainly urban), we find that in 1893-94 the tot schools in the remaining mainly rural distric were 986, while in 1897-98 they were 2,994, shov ing a rather higher rate of increase than in th purely urban districts. The scholars, owing the smallness of the rural schools, have n increased in the same proportion. It was on in respect of the years 1894-95 that on the initi tive of Mr. Henry Hobhouse, M.P., the Educ tion Department published exact statistics of the work of these schools, grouping them the same time by administrative countie If, therefore, we compare the scholars the mainly rural areas for that year, a in the years 1897-98 we find an increa from just over 103,000, to almost exact 150,000; on this evidence we may safe assume that during the whole period of s years the numbers in rural schools must almost doubled.

How has this result been brought abou Sir George Kekewich in giving evidence bef the Royal Commission on Secondary Educati said:—"In respect of continuation schools t School Boards held the field." Sir George m have been thinking of London, Manchest Birmingham, and other large towns, for in spect of rural districts the facts point to exactly opposite conclusion. We can test t statement by figures. In the years 1893-94 t rural continuation schools received from County Councils £8,050, in the year 1894- they received £12,481, and in the year 1897 £19,815 according to one Return, or £20, for another.

In the same period we find that the Sch Board rates devoted to continuation schools the same areas were only £6,917 in 1894-

ınd in 1897-98 had only increased to £9,916. Thus, whether we compare the increase or he actual expenditure in the districts, the nainstay of the schools as far as local support roes lies in the County Council, and not in the School Board grants.

But we can test the same proposition in ndividual cases. In the county of Somerset here are 77 School Boards, between them they give £68 to the Continuation Schools, which eceive (1897-98) £1,685 from the County Council. In West Suffolk 95 School Boards give £5 between them to some 61 Continuation Schools, which receive £905 from the County Council.

In the four Rural Counties whose Councils lo not aid their schools, viz., Beds, Oxon, Gloucester, and the East Riding, with an pproximate total population of 850,000, the ncrease in these schools in the three years has een 30 only, or 10 less than in the county of Cambridgeshire with a population of less than 25,000, the total schools in Cambridgeshire t present being approximately equal to that of hese four counties together. In fact, in the East Riding the scholars fell from 601 to 180 n this period.

In the county of Surrey, of the 29 School Boards 12 only conduct continuation schools t all, and four of these simply allow the eachers to manage them and to take the rants for their salaries, and this in spite of he fact that the County Council undertakes to hese Boards to double the Education Department's grants. In Cumberland again the County Council has just reported that "stronger neans must be taken to make School Boards o their duty."

On the other hand Her Majesty's Inspectors n various parts of the country have borne ribute to the work of county councils. I nnex a list of extracts compiled by the Organising Secretary for Cumberland, and aken from the 1898 Blue-book:—

"Much of the success of the Continuation School cheme is due, as has been pointed out in former ears, to the fostering care of the Derbyshire County ouncil. During the past year 80 schools, *i.e.*, in ct nearly all the country schools, were affiliated to e County Education Committee." [Rev. C. H. arez, North Central Division.]

"Regular attendance at evening schools is enuraged in both Dorset and Somerset by the unty council authorities, who give to every pupil aking 85 per cent. of possible attendances a certiate. The fees are returned too in many schools ıder the same condition." . . . . "Previous to the year 1893 there were but *three* evening schools in the district, but since the advent of the new order of things the number has increased by leaps and bounds. The more elastic arrangements secured by the Evening School Code, and the liberal assistance given first by the Somerset County Council Technical Committee, and later on by that of Dorsetshire, brought about a remarkable change." [Mr. Gordon, South-Western Division.]

"It is encouraging to report the thriving condition and steady increase of evening schools in the Bournemouth district. Subscriptions for evening school work being unattainable, and the grants under the Evening School Code being inadequate, the whole system would have fallen to the ground had not the County Councils of Dorset and Hants decided to offer a liberal aid conditional upon each evening school obtaining a grant under the code. [Mr. Mostyn Price, South-Western Division.]

"The number of evening schools in the district remains nearly constant; 46, comprising 58 departments, were visited in the past year. Of these all but 9 are connected with the Education Committees of the County Councils of Devon and Dorset, which are doing excellent work under the Technical Education Act." [Mr. Cowie, South-Western Division.]

"In Northumberland the departments have increased thus: 75 in 1896-7; 95 in 1897-8; 130 in 1898-9. Mr. Northrop says: This increase has not happened so much in the towns and large centres of population as in the distinctly rural districts, and the difference may be accounted for by the fostering care of the Education Committee of the Northumberland County Council. A large number of evening schools have been established, some of them being in very remote places, and carried on under considerable difficulties. The pecuniary assistance given by the county council has proved of great benefit, for the Government grant is insufficient to maintain small classes."

Now as regards the variety of action taken in various parts of the country. The following rural County Councils aid practically the *whole* of the evening continuation schools, and are their chief source of local support:—Cambridgeshire, Cumberland, Derbyshire, Devonshire, Dorset, Hampshire, Herefordshire, Hertfordshire, Leicestershire, the three divisions of Lincolnshire, Norfolk, Northumberland, Notts, Rutland, Salop, Somersetshire, the two Suffolks, Surrey, Warwickshire, Westmoreland, and Wilts, or twenty-five in all. All the aided schools in all these counties, except five, are also in receipt of Education Department grants. Four rural counties give no aid to their schools. In Cheshire, the County Council aids the rural schools direct, but leaves the urban schools to the mercy of their own authority; probably the same thing goes on in Essex to some extent, as the County Council aids 27 out

of 90 schools, but the urban bodies there do not appear to do their part as well as those in Cheshire. In Kent, continuation schools are very rare, and the County Council aids the rural ones only numbering 33 out of 47, the residue faring badly at the hands of the urban bodies. In Northamptonshire about one-half the schools are aided, and the others appear to receive nothing from the urban authorities. Sussex is badly off for continuation schools, about one-third of its 19 schools being aided by the County Council; a similar remark applies to Worcestershire, and to the North Riding of Yorkshire. In Durham the state of affairs is peculiar; there are 160 continuation schools (of course largely urban); very few of these, the Secretary writes me, at present (in the rural districts) receive recognition from the County Committee, as the great majority are teaching merely elementary subjects; that there should be 37 teaching reading and writing, and 121 arithmetic, in Durham, as against 2 and 11 in Somerset, is no doubt a result of the evils of the half-time system in manufacturing as opposed to agricultural districts; a stronger justification of the Robson Act of last Session it would be difficult to find.

II. I now come to my second point, "how the work has been done." I propose, first of all, to give a few facts and figures relating to the teaching in rural counties generally, and then to illustrate with the lantern certain concrete instances of this work with which I am acquainted. In the year 1897-98, elementary science was taught in 340 schools in rural counties; manual instruction in 215, drawing in 683; while for girls, 158 schools took cookery, but practically none laundry work, dairy work, or housewifery. As these figures relate to a total of 2,650 schools, it is safe to assume, allowing for the fact that the better schools take several of these subjects, that in much more than half of the rural continuation schools no subjects of a practical character are taught at all. It will be noticed that the returns make no mention of practical agriculture, practical horticulture, or school gardens; it is one of the blots on our system that these subjects are not, as yet, encouraged by the Education Department in evening schools. Twenty-eight of the rural counties have kindly given me detailed information as to the extent to which their continuation schools take some manual or technical instruction, science, or cottage gardening.

As regards Science.—In Surrey, 71 schools take the subject; in Somerset, 42; in Lincoln-Kesteven, 32; in Notts, 31; in Derbyshire and Lincoln-Lindsey, 20; in Norfolk, 18; in Hants, 17; Cornwall, Staffordshire, Hertfordshire, Dorset, and Leicestershire also make a special feature of this subject.

Carpentry and Basket-making are especially strong in Cambridgeshire, with 31 clases in the former, and 8 in the latter subject; Dorset and Notts are well forward in the same direction, while Cornwall encourages punnet-making in the fruit districts. Somerset has introduced wood-carving into 33 schools.

Cottage Gardening and Horticulture.—Stafford and Surrey have these subjects taught in connection with about 20 schools each; Kent and Somerset have introduced them with success, but in Hereford, in spite of offers, the schools do not avail themselves of the opportunity. Two or three other counties encourage this work, but I have no definite information from them. Lincoln-Kesteven teaches the theory of horticulture and agriculture in 13 schools.

It must not be supposed that other counties do not deal with these subjects, though they do not, owing either to administrative difficulties, lack of teachers, the code regulations, or want of support from school boards and managers, make them part of the continuation school system. East Sussex teaches all the above subjects in a system of separate classes. The Organising Secretary for Worcestershire writes: "Carpentry, basket-making, &c., are well taken up in rural districts not associated with evening continuation schools. We find such subjects are best taught by skilled practical men who regularly follow the trade, and there are difficulties in bringing this kind of instructor to the E.C.S."

As regards the very important point raised here the experience of other counties is different. For this stage of instruction, which is practically putting a top to the elementary system, my experience is that the ordinary teacher after a course of training either by means of Saturday classes or by a Summer Meeting is quite efficient. The course of weekly lessons given by the Cheshire County Council at Holmes Chapel, and by the North Riding in connection with the Yorkshire College are worthy of careful study, while the joint Devon and Somerset summer meetings at various places, and the Surrey and Kent meetings for teachers at Wye College, are the best known instances of the other system. Berks has recently started similar teachers

lasses partaking of both types at the Reading :ollege. A good instance of another kind f difficulty is set out by Mr. Donaldson of he Kesteven division of Lincolnshire, who vrites:—"Two years ago a school took up arpentry, but owing to the 17s. 6d. limit he grant was reduced by £12 8s., naturally uch a subject was not again attempted; he same remark applies to cookery and lairying, while time-tables comprising basket-vork are not approved by Her Majesty's In-pector, consequently the subject is taught s a special subject at the sole cost of the :ounty Council."

I now propose to show certain concrete xamples of what is actually being done in the ntroduction of practical teaching into evening ontinuation schools. I have slides showing his work in the counties of Cambridgeshire, Iampshire, and Surrey.

1. *School Gardens* (*a*).—I begin with two iagrams showing the general scheme of the ardens as devised by Mr. J. Wright, the ditor of the *Journal of Horticulture*, and hief instructor for the county of Surrey. I nay premise that these gardens are not in n experimental stage, but have been working or six years, during which, altogether, some-here like 1,500 children have been educated.

(*b*). Next we have five views of gardens in ne north of the county. The first set is ituated on part of the garden of the head-naster of the elementary school, who takes the eenest interest in the work, and who has also repared a large number of these slides for me.

(*c*). Following this there are three views of ardens in the south of the county. In all nese cases the School Masters are the eachers.

(*d*). Two views are presented of the pupils, ne set in the east and the other in the west f the county.

2. *Basket-making*. — These five slides ustrate classes in Surrey and Cambridge-ire. In one group will be seen the master the national school, who is qualifying to ach the subject, and the county councillor the district who acts as superintendent.

3. *Poultry-keeping*.—This set of five slides ows work for which Hampshire is pre-ninent, and which should certainly be taught all village schools where a teacher is ailable.

I now turn to more indoor occupations.

4. *Science Subjects* (*a*).—It must not be pposed that the horticultural work is only actical and carried on in the garden. On the contrary, theoretical teaching, illustrated by means of microscopes, and including the classification of plants and insects, goes on through the work. I have two slides illustrating a class at this work, and on the table are a number of the pupils' exercise books; also specimens of grafting done in the winter evenings.

(*b*.) *Elementary Chemistry and Physics*.—This first slide shows the box of apparatus furnished to the schools in Surrey. It illustrates a course of Heuristic instruction (now in the code) drawn up by Professor Armstrong's late lieutenant Mr. Hugh Gordon, now a Science and Art Inspector. The next view shows a form of cupboard lecture-table, which draws out as an extension of the apparatus; the boys at work are not evening school boys, but scholarship pupils. The next three slides show classes in evening schools actually at work in the schoolroom so provided.

5. *Repoussé Work*.—I have five slides showing how the work is carried on in Cambridgeshire continuation schools. It is extremely interesting, and often serves to create a village industry.

6. *Library*.—Finally, I have two views illustrating the village library scheme of the Cambridgeshire County Council. All the continuation schools have boxes of books sent out each session to form a circulating library for the pupils, and these are replenished from the central library at Cambridge.

I shall probably be asked as to the cost of all this work, and especially where the apparatus comes from. The only possible source of supply is the county council. On an average it costs £10 to start a school in apparatus, but if this is a loan, and carefully looked after by a central body which changes it, keeps it up to date, passes it on, and repairs it as the case may demand, the cost after a couple of years need not exceed £1 for a school. In fact 70 schools last year were re-supplied for £50. A group of school gardens with a dozen pupils costs, to start, including preparing ground, fencing, tools, and shed, about £17, and to maintain as regards teaching, seeds, and prizes, £8 a year.

III. Now as to my third head: "What remains to be done?" In the first place there must be a better organisation. One may look with longing upon the compulsory systems of Saxony and other German States, but I am convinced that they will never be accepted in England except as an alternative to compulsory military service, or compulsory day school

attendance. One cannot fine parents or employers of semi-adults up to eighteen years of age if these do not attend the schools ; nor do I think the indirect compulsion of preventing young people marrying unless possessed of a continuation school certificate would ever be approved among us. If there is to be compulsion the line of least resistance is that taken by that hardy annual, Mr. Samuel Smith's Evening Continuation School Bill, which makes evening attendance (to the age of fifteen) a condition of a certain period of day exemption. The agricultural clause of the Robson Act gives just such an opportunity ; if this is to be worked satisfactorily the continuation school must come into more prominence, and indeed be the key to the rural educational situation. It must be recognised once for all that the continuation schools have come to stay, not as a recent otherwise well-informed writer on educational reform puts it : "A makeshift and temporary system." But the question then arises how are we to compel the rural voluntary school, not to say the rural board school, to provide the necessary supplementary continuation schools. I quote Mr. Samuel Smith in the *Contemporary Review* of July, 1891, on this point :—

"When they come to see that these schools can be made most helpful to rural life, that such things as irrigation, drainage, rotation of crops, and cottage gardening can be taught, also elementary chemistry, the structure and life of plants and animals, dairying, and the rearing of cattle, sheep, pigs, and poultry, they will find that the farmers could not make a better investment than to train their own and their labourers' sons in such useful knowledge. The dislike of large classes of persons in this country to continued education is largely because of its unpractical character. Our system was originally framed by men who may be described as educational pedants, who themselves only possessed literary training, and could not conceive that the child of a poor labourer needed anything more important than accurate spelling or grammar. That grotesque theory of education is now rapidly passing away. It is beginning to be seen here, what many other nations have seen ages ago, that education should be a training for life, that the mass of our population need to have the hand and eye trained as well as the mind, and that even the mind is far better trained through the eye than by barren words. I am convinced that the repugnance to school life will pass away just as rational views of education gain ground. It is possible to conduct a school so as to make it the happiest time of life ; even the child of a stolid Dorsetshire labourer can be taught in such wise as to brighten his life and give him real recreation, and I look forward to the time when our too moderate proposals for co[ntinued] education will be carried still farther."

But to supply this practical and attracti[ve] instruction means, as I said before, "organisa[tion." It means "grouping and peripatet[ic] teachers." It means county funds applied n[ot] spasmodically here and there, but *sempe[r] ubique, ab omnibus*. There is only o[ne] means of bringing this result about, an[d] in the language of the resolution of th[e] Agricultural Education Committee : "[It] should be made part of the duty of ever[y] county organisation (outside London an[d] the county boroughs), recognised und[er] Art. VII. of the Directory, to organise suc[h] schools throughout their county, to receive an[d] supplement the grants made by the Board o[f] Education, and to supply and pay qualifie[d] teachers. In many cases villages would hav[e] to be grouped, and peripatetic teacher[s] employed." This resolution curiously enoug[h] actually receives the approval of the Nationa[l] Union of Teachers. It is only thus by makin[g] the real local paymasters the responsibl[e] authority, and by stopping the present syster[m] of trying to serve two masters, that efficienc[y] and economy can be combined.

The question of peripatetic teachers paid b[y] a *pro rata* contribution from the school fund[s] of the grouped schools assisted, with count[y] council grants added, is most important. Th[e] village mixed day school, staffed by a mistres[s] with one or two pupil teachers to help, canno[t] supply the staff for an evening school. Man[y] of the rural masters even have not yet had a[n] opportunity of acquiring knowledge in practica[l] subjects. I desire a district evening schoo[l] committee to be formed for, say, a dozen o[r] two schools in the area of each rural distric[t] council, such committee to act as an advisor[y] body to the local managers, supplying them where desired with peripatetic teachers, an[d] keeping all under the general scheme of th[e] county council.

As to the actual results of a well-establishe[d] county system I have letters of testimony fro[m] many quarters. I will give two. Mr. Maudso[n] Grant, of Lincoln-Lindsey, writes : "It i[s] only three years since we (the Count[y] Council) took our evening schools out o[f] the hands of the local committee. U[p] to three years since there were very few o[f] these schools working ; the first year we too[k] them over there were 30, the second 50, an[d] this year 53 ; certainly during these years the[y] have increased in numbers and efficiency." Mr. Bottomley, of Somerset, says : "By carefu[l]

ntral administration it has been found possible reduce the proportionate cost of these schools ry materially as compared with four or five ars ago, although the schools are larger, tter equipped, and the same rate of remunera- on to teachers is maintained."

Secondly, it is necessary that the system of e Education Department's grants to these hools should be revised. Rural subjects ould be insisted on in rural schools, and paid e highest grants; poultry-keeping, bee- eping, manual instruction, and gardening, ould not be penalised as they are now. very school taking two or three of these, with me interesting recreative subject super- lded, should be ensured a block grant of at ast 3s. or 4s. an hour. Again great latitude ould be given as regards the season and place r this rural instruction. It should go on roughout the year, and much of the practical rk should be done outside the school in the mmer evenings. Visits to orchards, poultry d bee farms under a competent instructor e of the highest educational value, and should paid for by the Education Department. is will get over the great present difficulty of eping in touch with the boys from session to ssion. Through the kindness of the Bishop Winchester, and other local gentlemen, on veral occasions I have arranged that picked ys, who have had two or three years' school rden teaching in the Farnham district, should taken by a practical lecturer round glass- uses and orchards, and should learn some the secrets of profitable gardening in its her branches.

As to school gardens, I cannot be too strong. is amazing that the Department should ke grants for these when cultivated by day ool children, who, in the country, leaving ool under 10 as a rule, are not strong enough lo the work, and that it should refuse grants he evening school boys of 14 or 15, who are t at the age to take keenly to such work. t I will be confronted with the difficulty of ting land for this purpose, if the system is become general. Hitherto, I have found t where the school managers have this iculty, a neighbouring landlord readily nes to their assistance. But in all cases it uld be possible to supply the ground if the ish councils were allowed to set aside an tment or two for the purpose. Unfor- ately, the law does not let them use their vers under the Allotments Act for education. ny of them have expressed a desire to p, but the auditor of the Local Govern- ment Board refuses consent; surely the necessary alteration in this law should not be a matter of difficulty.

I do not propose to go into all the grievances of the rural continuation school; some they share with the urban schools, such as the docking of grants for good work and long hours under the 17s. 6d. limit. But I must touch upon the evils of the system known as the labour certificate, as it affects rural schools. The rules of the Department do not allow grants in evening schools to be earned by day scholars or even by ex-day scholars, who have not received the so-called labour certificate; this means that a large number of unfortunate children who have left the day school are shut out from the evening school because Her Majesty's Inspector has not the time to go through the farce or formality of holding a labour certificate examination in their district; until the age and attendance exemption is the rule, and this examination goes the way of all others, we are bound to have our village streets over-run with what might be some of the best material for the evening school. The point is well put by the Kent superintendent who says:—

"Practically all a local committee have to do is to secure the participation of 10 to 15 boys from 13 to 16 years of age. I am well aware that this task is not so simple as it would be if we were allowed to include boys at school. It is a constant source of regret that promising lads who are at school in autumn, when our classes necessarily begin, but who will be leaving in the course of a few weeks, have to be rejected. Still, I think that classes could be got together with a little trouble in various places where they are not in existence now."

It is easy, of course, to argue in towns that children will be subject to over-pressure if they go to school in the day as well as in the evening; this cannot be true in the country for the upper children if the evening school work is made recreative and interesting. It is not an argument at all if the day work is done in the winter only, and (for Robson agricultural children) the evening work is largely taken in the open air on summer evenings.

The final reform which I propose is for the Education Department to give up its present system of classifying continuation schools.

What meaning have the words Board, Church of England, Wesleyan, &c., in connection with continuation schools? They refer only to the building in which some of the classes are held, and are absolutely without

reference to the teaching and frequently without reference to the financing and managing body. For instance, I know a continuation school held in a Nonconformist day school building entirely under the management of a voluntary body of persons of other denominations, and another held in a board school, with which the school board have nothing to do except exacting a highly remunerative rent to relieve its rates. What is wanted is a rough classification by counties into rural and urban schools, which can best be done by showing the populations by thousands of the school districts involved.

In conclusion, why do I lay all this stress upon these special types of evening education for the rural districts? Because I believe that, in the main, it is not what is taught to the child below 10 which matters as long as something is taught well, but it is what is taught in the early years of youth and manhood which directs the life and forms the character. Because I am convinced, also, that all this work is not specialising in any anti-educational sense, but is the true education for not only all those who *must* live, but for all who *might* live, in touch with nature. I say "all," and I thrust aside the stupid fallacy that this is only intended for "prospective farm labourers." Go into any village to-day and see who are the best cultivators of their gardens and allotments. It is the village carpenter and blacksmith, the road or railway labourer, the policeman and the postman, even the grocer and the baker and the keeper of the general shop. Are not these also in many cases the most intelligent men in any subject? What, also, of the village schoolmaster? Is he not to have his garden and to know how to cultivate it? With Kipling I believe that for all these it is better that they should *do* something than sink to the level of Chinese competition-wallahs or Indian baboos. But I go further and say that the economic problem of the depopulation of the villages can thus be touched if only on its fringe. The man who keeps to agriculture in any branch without bankruptcy, in my observation, is the man who has another trade or profession as well. In the lower walks of agricultural life this means the "handy man." If it is clear that the difference of margin between the wages to be earned for the all-the-year work in the town and for the part-of-the-year work in the country can be made up by a winter trade, carpentring or basket-making for instance, or by a cultivation of the man's own garden. If there is found, coupled with th extra profit, the keen interest in these pursui which can only be derived from an educatic in and knowledge of them, we will attac at any rate the outposts of the well woı *panem et circenses* argument of the scoffe at rural education. Last, but not least, th child trained as I propose, ignorant it may l of grammar and polite literature, but with ey that see, ears that hear, and a mind th understands his surroundings, will in the tir of difficulty and danger have the nerv physique, and intelligence to march har take cover, and shoot straight.

DISCUSSION.

The CHAIRMAN said the paper to which they h listened with so much pleasure had given mu up-to-date information as to the position of Eveni Continuation Schools. He would not cast a sl upon their common sense by attempting to argue favour of Evening Continuation Schools, but wou merely say that it had been a puzzle for years pa to those who had taken an interest in the subje how we, who pretended to be a practical peopl had been content to support a system whereby t quickest and sharpest children were made to suff more than the dullest, he could not understan At present, the quicker the child passed throu the Standards, the longer the period during whi all knowledge would be forgotten. The informati given by Mr. Macan led them to suppose that the was a great forward movement as regards Eveni Continuation Schools. The committee with whi he (the Chairman) was connected had been taki considerable interest in this matter, and he mention this for one purpose alone—viz., to show that th had been putting strong pressure upon the ne Education Department, which was being form under Act of Parliament, and which wou come into being on 1st April, with reference various educational matters, and in connection wi elementary schools they had been met by the Depar ment in a most liberal spirit. Advance had been ma far beyond what might have been anticipated wh the work of the committee was commenced a fe months ago. A system of block grant had be introduced into the elementary schools, whi would be extended, he hoped, to the Eveni Continuation Schools. This was the only possib foundation for securing the change which they had view. In addition to that, there were serious alter tions in the new Code with regard to the curriculu This was valuable as regarded elementary school but they must take care that whatever improveme was obtained in the elementary system, they shou proceed *pari passu* with a serious extension of t Evening Continuation School system. He ne

-dly point out that the better the system of cation in elementary schools, the more criminal ıld be the neglect if they did not secure Continuaı Schools to complete the education. Having had ıe experience in educational matters, he believed t for the first time in our history there was a solid vard movement with regard to such matters. e figures quoted that evening with regard to Conıation Schools were of a most hopeful character. e remark at the end of the paper, with regard to ssifying schools, touched upon a great difficulty in nection with the educational system. Many had ed why it was they had this kind of patchwork tem of education, and he had been obliged to come the conclusion, that excellent as was the commise come to under Mr. Forster's Act, yet the npromise of 1870 had not proved a good ndation on which to build the future of ication. No man in or out of Parliament had re strenuously endeavoured to protect education n the semblance of party strife than himself. He l endeavoured to drive an even keel between coming systems, but jealousies existed, and these were differences which stood in the way of Parliant and the Department. Happily for them local lies were now taking up the question, and when e the local bodies began to feel their strength in ıcational matters the matter would be carried ough; and it would be the duty of those in Parnent to avoid all party strife and to organise and ordinate local authorities, and to give them every ssible encouragement. When once the local horities got a grip of education they would never ve go their hold of it, and a system would be introed which would be worthy of a sensible people.

Sir PHILIP MAGNUS said he had come to the eting as learner, and he thought those who ıe in the same capacity would go away like ıself feeling that they had learnt a great deal n the able paper which had been read. Mr. Macan l given them a large amount of useful information l particulars of the work done in rural schools by ich they would all profit. The schools referred belonged really to two classes—schools for continuation of ordinary education given in mentary schools, and those for supplement- such education by the teaching of some ful handicraft. In the new organisation of Education Department, it was difficult to to which section of the Department these two sses of schools would be referred, but a matter the utmost importance to the future welling of the country, was that the elementary teach- of primary schools should be immediately and some little time sedulously continued. It was hing less than a calamity that the education en in elementary schools should cease as soon the child left school, and that there should a long blank between the time of leaving school and of entering the technical classes, which prepared scholars for industrial work. The Continuation School was the link between the primary school and practical work on the one hand, and the primary school and the technical school on the other. For this reason it was most important that instruction in rudimentary science should form a part of the system. Supplementary schools were also of the greatest value—schools in which a boy or girl was taught some useful handicraft which should help to eke out the meagre wage to be obtained from agricultural pursuits. Education of this kind had the effect of increasing the wages of the pupils, and at the same time of making agricultural work profitable, where, otherwise, it would not be so. Schools providing such practical teaching existed in the rural districts of all Continental countries where important industries were developed, which enabled agricultural work to be carried on at less cost, and native labourers to compete on advantageous terms with persons similarly employed in this country. Again, by supplementing the wages of the agricultural classes, we might do something to encourage people to remain in the country, and at the same time we help to make their lot happier than otherwise it would be. But it was highly important that these schools should be properly organised, placed under suitable inspectors and conducted on the best principles, with sufficient funds to enable them to be properly developed. He anticipated very good results from the alterations in the Code which had been referred to. They were all on the tenter hooks of expectation to know what would follow the reorganisation of the Education Department at the end of the present month.

Mr. AUSTIN KEEN, replying to a question as to the class of books kept in the village library referred to in the paper, said that in Cambridge the books were of a rural character, dealing with agriculture, horticulture, and the like.

Rev. ERNEST FLOWER said Continuation Evening Schools were necessary to carry on the work of education. In London we were in danger of forgetting the appalling facts with which one had to deal in rural districts, where hundreds of thousands of young people who passed through the elementary schools could not read, write, or cipher decently in the most elementary standard. In support of this statement he quoted extracts from the reports of Mr. Donaldson and Mr. Ranken. They had to face this fact, and the question was how were they going to deal with it? They must not allow those provisions of the Code to remain which excluded committees from dealing with such scholars, and then being repaid out of the national exchequer for the cost of doing so. At a recent conference on education, a Swede, when asked about the question of the

cost of teaching poor children, said, "We Swedes are not rich enough to allow poor children to grow up untrained, they are the most costly elements in the whole community." Teaching practical subjects would not only develop young men and women, but would do an immense amount towards annihilating the absurd and incomprehensible antagonism to education which existed amongst many—the clergy, squires, and well-to-do-farmers. The only hope for us, as a nation, was to rescue the uneducated material from the condition in which it was at the present day, especially while it was in the most plastic state, as well as at the most dangerous period of life, viz., from 12 to 18 years of age.

Sir EDMUND VERNEY, Bart., said there were passages in the papers pitched in an entirely different key from that with which he was familiar, such, for instance, as the remarks of Mr. Samuel Smith. They had nothing of that sort in Buckinghamshire. Mr. Macan suggested that the County Councils should help, but in Bucks the County Council did all they possibly could to hinder education, the members considering that they were merely elected to keep down the rates. He had known labourers and their wives, with tears running down their faces, complain of the children being kept at school when they might be earning money. The farmers hated education, and the farmers were the managers of the schools. In one instance they suggested that hedging and ditching should be taught, and after a great deal of difficulty the County Council was induced to vote money for this purpose, but when a teacher was obtained not a single pupil attended. The farmers on being asked why they would not support the movement fenced with the question, but on being pressed one said he was not going to let his men attend the classes because if they were taught hedging and ditching they would discover that they could earn a better wage, and would leave. On some of the young men being approached upon the subject, they said they had never done that kind of work, and they did not want to do it. Again, as to the suggestion that you should compulsorily teach rural subjects, he thought this would be extremely dangerous. In the agricultural districts a number of children were asked to write on a piece of paper what they would like to be when they grew up, and only one out of one hundred said he would like to follow an agricultural pursuit. Were you going to bring compulsion upon them? If you did they would go off to the towns.

Mr. H. MACAN said there was no such suggestion in the paper; indeed, he had said that compulsion was impossible.

Sir EDMUND VERNEY said he had evidently misunderstood the drift of the suggestion. He thought it would be extremely interesting to have some inform tion as to the number of applicants for books fro the village library. He knew one parish with a pop lation of 220, which had a penny rate, bringing in t large amount of £9, and it had a library of 2,5 volumes, the weekly issue of books being between and 60.

The CHAIRMAN, in proposing a vote of thanks Mr. Macan, said this gentleman was a practic worker in the cause of education. No doubt it w perfectly true that many years ago throughout t greater part of rural England there was a distaste education, but a vast change had now come over t inhabitants of these places upon the subject. Th must put their shoulder to the wheel in this matt and do their best to create public feeling in favour education in places where it was against it. A gre deal had been done in this way in Cheshire and Ca bridgeshire and other counties, and he had no dou the object-lesson would be followed in other places.

The vote of thanks having been passed,

Mr. H. MACAN said he had not heard any criticis from any quarter upon anything contained in t paper. He might give an example of how it w possible by strenuous effort to overcome oppositi in rural districts. There was an institution of t county of Kent, called the South-Eastern Agricu tural College, at Wye, to which violent oppositi was offered when it first started; in fact, one farme club passed a resolution to the effect that the Coun Council was throwing away its money by havi anything to do with such an institution, b the County Council paid no attention to t farmers' club, and started the college. Wh it was in full working order, the members of t farmers' club were asked to come and see t work carried on, the condition of the farm, and t sheep that had won prizes at Smithfield, and also hear the lectures delivered. They came, and th winter that club elected the principal of the colle as its president. He had not been able to give a statistics with regard to Bucks, for the simple reas that from the first it had no system of central organis tion. They had now awakened to the necessity having an organising secretary, and last week o was appointed. Other County Councils took th step nearly ten years ago. Judging from what heard, he attributed this discouragement to Technic Education to the fact that some of the classic masters at Eton occupied seats on the Buc County Council. It was true that in certain parts the country there was a deplorable lack of eveni elementary and other education at the present tim but that was a state of things which was gradua passing away, and need not be legislated for, and was our duty to remedy this, to try and improve t conditions of the elementary day schools, as well the attendance at them.

Miscellaneous.

PORTUGUESE WINES.

There are no correct statistics of the amount of ne produced in Portugal, according to Mr. arrison, Commercial Attaché to Her Majesty's gation at Lisbon. Wine is made by private rsons in all parts of the country, so that the antity taxed for consumption is no guide to the tal quantity manufactured. According to the timate of the Director-General of Agriculture, the antity of wine produced in Portugal in the year 98 amounted to 5,500,000 hectolitres (121,000,000 llons). The quantity of wine exported amounted only 864,000 hectolitres (19,008,000 gallons), so at should the above estimate be correct upwards of 500,000 hectolitres (99,000,000 gallons) remained to consumed in the country. In spite of the demands r sound red wine at cheap prices, and the evident ct that the natural resources of Portugal are suitable r producing wines of this class, but little has been ne to improve the methods of wine manufacture, so at the large surplus production of common wine is actically wasted, and a great quantity of the wine w made is of a quality that is of no commercial lue. At present the value of the Oporto wine is nsiderably more than half the value of the total antity of wine exported from the country. lthough the better kinds of red and white wine are eatly appreciated by those who know them, they e not suitable for exportation. The markets for the mmon wines are almost confined, therefore, to azil, the Portuguese colonies, and countries where e Portuguese population can be depended upon for nsumers. Apart from the port wine, therefore, the pabilities of Portugal as a wine-producing country e wasted, through want of initiative in improving e method of manufacture, so as to make wine ited to the demand in the European market. The anufacture of port wine is the most valuable trade Portugal. In the year 1898, 313,000 hectolitres ,886,000 gallons), valued at £916,000, were exrted, as compared with 280,000 hectolitres ,160,000 gallons), valued at £831,000, in the preding year. There has been a small but steady inease in the quantity of wine exported from Madeira ring the last seven years, the quantity having ached 24,000 hectolitres (528,000 gallons), value dat 111,000, in the year 1898. One-third of the total antity of Madeira wine is shipped to the United ingdom. The exportation of common wine nounted to 475,000 hectolitres (10,450,000 gallons), lued at £548,000, in the year 1898. The amount revenue derived by Portugal from customs duties wine, beer, and spirits in the year 1898 was 36,000, and the excise duties £239,000, making a tal of £275,000, as compared with the whole venue of the State, amounting to £7,506,000.

Correspondence.

ETYMOLOGY OF AFRICA AND OPHIR.

Dr. Carl Peters' contention that the place name Africa is nothing but the Latin form of the unmeaning Semitic "loan" place name Ophir, is historically and etymologically untenable. Africa, the name by which the Libya of the Greeks became known to the Romans through the Carthaginians, was at first applied by the former exclusively to the territory, subordinate to Carthage, stretching between the inland hilly tract of Numidia, the "Nomad country," in the west, and the low-lying "Syrtica Regio," or "Desert [Egyptian *tsert*] country," bordering the Mediterranean Sea on the east: and when the Romans gradually extended the name of Africa eastward over the whole of the continent north of the Sahara [literally "Wastes," being the Arabic plural of *sahra*, "extended," and compare our "vast," "waste," and the Latin "vacuus"], they still distinguished the Carthaginian district, as "Africa Propria," and "Africa Vera." Similarly when the whole "clime of the East," "the land of the Sun," came to be called Asia, classical geographers still distinguished as "Asia Propria," corresponding with the Roman "Asia Proconsularis," and more roughly with our "Asia Minor," the country around Ephesus, the city of "the Great Asiatic Goddess"; first, as is now accepted, named Asia, from *asu* [compare Sanskrit *ushasa*, "dawn," Eōs, east, Ephesus, Easter, &c., "Aurum," El Dorado, &c., ? Aurora], the "Eastern," or "sun-Rise-land," by the Phœnician traffickers in the Ægean Sea, in contradistinction to the opposite coasts of Europe, that is, *erib* [compare Erebus, Orpheus, ? Hesperus, &c.] the "Western" or "sun-Set-land." The Greek *Aphrikè*, was a comparatively modern transliteration of the Latin Africa; and the name obviously came into Italy, and, through Italy, into Greece, not from Eastern Africa, but from Northern Africa; and it is simply the Phœnician, or Punic *Afrykah*, "the colony," that is of the Sidonians and Tyrians who in succession settled this part of Libya between the 10th and 8th centuries B.C.; while Carthage, replanted by the Tyrians on the site of the earlier Sidonian settlement of Byrsa, that is *bozra*, "the fortress-factory," is the Phœnician *Keret-chedeschat*, or "New-town," the Greek *Karchedon*, and Roman Carthago.

As for Ophir, this place name did probably include the south-east coast of Africa, but it equally included the south coast of Arabia, and the whole coast of Western India, with Ceylon, and possibly also the Malayan Peninsula — "Aurea Chersonesus," — of Farther India. The term, in short, as used in the Bible, may be compared with the Parvaim [compare Sanskrit *purva*, "Eastern"] of 2 Chronicles iii. 6, and our "East Indies"; and, less per-

tinently, with the classical Eöus and Panchaia. It occurs as Ophir in Genesis x. 29; 1 Kings ix. 28, x. 11, and xxii. 48, 1 Chron. i. 23, and xxix. 4, 2 Chron. viii. 18, Job xxii. 24, and xxviii. 16, Psalms xlv. 9, and Isaiah xxiii. 12, and as Uphaz in Jeremiah x. 19, and Daniel x. 5; and in all these references, excepting Genesis x. 29, and 1 Chron. i. 23, Ophir and Uphaz are associated with gold. In its Greek form the word is written Ouphir, Opeir, Oppheir, Souphir, Soupheir, Sōphir, Sōphira, Sōphera, Sōphara, and Sappheir. Ptolemy places, vi. 7, 41, a Sapphara on the southern coast of Arabia, and, vii. 1, 6, a Soupara on the coast of Western India; and, vii. 1, 15, a Sippara on the eastern coast of India; and there is a "Sofala thought [Milton meant by Purchas] Ophir" on the south-eastern coast of Africa. These four place names are all cognate with Ophir, and not with Africa, which, as has been shown, is quite another word; and I believe the Soupara placed by Ptolemy on the coast of Western India to be the original Ophir of them all. King Solomon's trade, by means of "the navy of Hiram," and "ships of Tarshish" [Tartessus, *i.e.*, Spain, and compare the term, "Indiamen"], included imports, expressly invoiced from Ophir [1 Kings x. 11], of "almug trees and precious stones," and, not expressly invoiced from Ophir [1 Kings x. 22, and 2 Chron. ix. 21], of "gold and silver, ivory and apes, and peacocks." All these are Indian products, the "almug trees" and the peacocks being exclusively Indian products, and the names used in the original text of the above quotations for ivory, and apes, and peacocks being, every one of them, Indian names Hebrewised:—*shen-habbim* literally "tooth of elephants," for "ivory," being formed from the Sanskrit *ibha*, "elephant;" *kophim*, for "apes," being the Sanskrit *kapi*; and *tukkyyim*, for "peacocks," the Tamil *tokei* or *togei*. This is sufficient to prove that from King Solomon's time, and from the earliest times, the Hebrews knew of India in its trade productions; and in this way, at least, it was universally known to antiquity. Indian teakwood has been discovered in the structural ruins [Mugheir] of the temple of "Ur of the Chaldees." An ancient Babylonian list of clothing mentions *sindhu*, or "muslin," which Sayce [*Hibbert Lectures*, 1887] identifies with the *sadin* of Judges, xiv., 12, 13, translated in the English Authorised Version by "sheets," and in the Revised Version by "linen garments," and the *sindon* of the Greeks, the "cendal" or "sendal" of Mediæval Europe; all these denominations signifying "Indian"-stuff. In the original text of Esther, i., 6, the wood translated "green" is *karpas*, the Sanskrit *karpasa*, and Greek *karpasos*, "cotton," and instead of the passage reading "white, green, and blue *hangings*," it should read "white and blue cotton *dharis*," the striped floor-cloths and hangings for which India has always been noted. There is no undoubted mention of silk in the Old Testament, but silk is rightly supposed to be referred under the denomination of *meshi* in Ezekiel, x 10, 13, translated in both the Authorised and t Revised Versions of our Bible by "silk," and *demeshek* in Amos, iii., 12, rightly translated "Damascus" in our Authorised Version, and wrong by "silken" in the offensive Revised Version. the Book of Esther, moreover, India is twice [i. and viii. 9] referred to by its vernacular name, in t Hebrewised form of Hoddu, in Syriac Hondu, Arabic Hind, in Persian Hindu, in Greek *Indik* all these being variants of the Sanskrit Sindh literally "a river," but especially the river Indus.

The Hebrew place named Ophir has no meanin but Soupara [Ptolemy, vii., 1, 6], identified James Burgess, the eminent Indian antiquary, wi the modern Supārā, a few miles above Bassein in t Northern Konkan, means the "auspicious-far"-sid or opposite bank, or coast, that is "the fair tradi coast" [compare Surat, *i.e.* Su-rashtra, the "Fair —merchant—"kingdom"], to distinguish it possib from the dangerous trading coast, *Ariake Andr Peiraton*, of the Southern Konkan. Sippara is sa to have the same meaning, and both names may compared with the Greek *Paralia*,* "coastland applied to the broken maritime tract of Atti stretching southward from Mount Hymettus Cape Sunium and the Saronic Sea, to the weste coast of Chalcidice, opposite the Pierian shores Macedonia, and, by Ptolemy, to the coast Travancore. The people of Western India, par cularly those about the Gulf of Cambay, ha from the remotest past actively trafficked with t south coast of Arabia, the Persian Gulf, the R Sea, and the east coast of Africa; and it would quite natural for them to have carried with the the name of their own famous port of Supā and applied it to the chief emporia of their tra in the Hadramaut, and the Zanzibar, or "Blac Coast," of Africa; the Arabs in the latter country, seeking to give it a meaning in their own tongue, twi ing it, with but slight change of sound and significar into Sofala, at full length, Sofalatu'l Dhahab, t "Coast of Gold," an extension of form which inde seems to emphasise its indication as a variant Ophir. Finally, to this day India is the Sofir, th is, Ophir, of the Abyssinians and Egyptian Cop Whatever eastern lands, therefore, may be includ

* "Paradise"—at one time thought to be derived ul mately from either (1) the Sanskrit *para-desa*, "a fa "a foreign country," *para-desi*, corrupted to "purdase being the name given in the Deccan to natives *cf:* Hind stan, or (2) from the Sanskrit *purva-desa* [of "Parvain above], "Eastern country," familiar in the adjecti form of *parviya*, corrupted to "purboe," originally name given to Hindus living to the east of the Gang and then applied to native "writers," and "clerk generally,—is now traced to the Zend *Para-daeza* "(closure," in Persian *firdauz*, "a garden," "a park," in Gr the "loan word" *paradeisos*, and so our Paradise, t Garden of Eden, Heaven, &c., and parvise, the porch un a church tower, or the room above the tower porch, the "cloister close" of Cathedrals, that of Chiches being still called Paradise, and of Chester Sprise Garden

the Biblical Ophir, India of the Hindus is the original, authentic, definite, and inexpugnable Ophir; while the word Ophir has nothing whatever to do with the word Africa, great as I trust may be the "golden joys" the dark continent of that name has in store for those pioneers of modern civilisation among whom so high a distinction has been achieved by Dr. Carl Peters.

GEORGE BIRDWOOD.

March 12, 1900.

Obituary.

G. J. SYMONS, F.R.S.—Mr. Symons, the eminent meteorologist, died after a short illness on Saturday, the 10th inst., at his residence in Camden-square, at the age of sixty-two. He took up the study of meteorology at an early age, and before he was twenty-one he had lectured on the subject and commenced a series of observations with standard instruments, the records of which were supplied to Mr. James Glaisher, F.R.S., for insertion in the "Quarterly Reports" of the Registrar-General. In 1857 he started an organisation for the observation of thunderstorms and the record of injuries by lightning. The great work of his life, however, was the organisation of the British Rainfall System. In 1860 he began by publishing a summary of the rainfall of 1859, collected from about 100 records, and this led him to form a regular organisation for observing and recording the rainfall day by day in different parts of the country. Beginning with 168 observers in England alone the number of observers scattered over all parts of the British Isles now reaches over 3,000. In addition to the recording of the current rainfall, Mr. Symons collected and classified the previous existing records, so that all the information on the subject since 1677 is available.

In 1894 he read a paper before the Society of Arts on "British Rainfall Records," and in 1897 he was awarded the Albert Medal "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and sewage of towns a trustworthy basis for their work, by establishing and carrying on for nearly forty years (now at over 3,000 stations) systematic observations of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself." He also received the Telford Premium of the Institution of Civil Engineers.

Mr. Symons was elected a Fellow of the Royal Society in 1878, and in 1884 was appointed Chairman of the Krakatoa Eruption Committee, the elaborate report of which he edited (1888).

He was hon. secretary and past president of the Royal Meteorological Society, and he was re-elected president this year in the hope that he might preside at the forthcoming commemoration of the Society's fiftieth year in April next. Besides the publication of thirty-eight volumes of "British Rainfall," he started and edited the "Meteorological Magazine," of which thirty-three volumes were published. He also edited the Report of the Lightning Rod Committee (1881).

General Notes.

RECEIPTS OF PARIS THEATRES IN 1899.—The statistics of the theatres and places of amusement in Paris in 1899, have just been issued by the *Administration de l'Assistance Publique*, and these show that the receipts were greater than in any year since the returns has been issued—amounting to as much as £1,326,400, as compared with £1,205,600 in 1898. The nearest approach to last year's figures was in the Exhibition years of 1889 and 1878, when the receipts amounted respectively to £1,283,560 and £1,226,280. Taking the various items that go to make up last year's totals, it is found that as usual the Opera heads the list with £114,512 the Opera Comique comes next with £81,152, the the Comédie-Français with £74,452, and then follow the Nouveautés with £54,256, the Châtelet with £52,276, the Folies-Bergère with £50,096, and the Variétés with £47,976. The Vaudeville, Porte-St. Martin, Nouveau-Cirque, Olympia, Sarah Bernhardt, Scala, Gâité, and the Casino-de-Paris follow next in the order of their importance.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MARCH 21.—"The Use and Abuse of Food Preservatives." By DR. SAMUEL RIDEAL. OTTO HEHNER, F.I.C., F.C.S., will preside.

MARCH 28.—"Leather for Bookbinding." By DOUGLAS COCKERELL.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Cultivation, Manufacture, and Use of Indigo—Position of the Industry in India." By CHRISTOPHER RAWSON, F.I.C. SIR WILLIAM BRERETON HUDSON, K.C.I.E., will preside.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General. The Right Hon. SIR FRANCIS HENRY JEUNE, K.C.B., D.C.L., will preside.

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

Foreign and Colonial Section.

At 4.30 o'clock :—

April 2 (Monday). — "The Century in our Colonies." By the Right Hon. Sir Charles Wentworth Dilke, Bart., M.P. The Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., LL.D., will preside.

Applied Art Section.

Tuesday evenings at 8 o'clock :—

April 3. — "Process Engraving." By Carl Hentschel. William Luson Thomas will preside.

April 24.—"The Practice of Lettering." By Edward F. Strange. Sir William Abney, K.C.B.. F.R.S., will preside.

May 8.—"Art Metal Work." By Nelson Dawson.

Cantor Lectures.

Monday evenings at 8 o'clock :—

E. Sanger Shepherd, "Photography of Colour." Four Lectures.

Lecture III.—March 19.

The Representation of a Coloured Object in its Natural Colours.—White light—Young's theory of trichromatic vision — Spectrum colours and colour mixtures—Processes based upon Young's theory—Light filters for trichromatic photography — The negative—The preparation of transparent prints in natural colours for the optical lantern.

Lecture IV.—March 26.

The Application of the Trichromatic Method of Colour Photography to the Printing Press.—Light filters—Suitable plates and negatives—Preparation of the printing surfaces—The half-tone process, its faults and difficulties—Inks—The printing of the three impressions—Colour-printing machinery.

MEETINGS FOR THE ENSUING WEEK.

Monday, March 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. E. Sanger Shepherd, "Photography of Colour." (Lecture III.)

Sanitary Institute, 74A, Margaret-street, W., 8 p m. Dr. R. Dudfield, "The Practical Duties of a Sanitary Officer."

Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. W. Albert Hickman, "New Brunswick and Great Britain."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Messrs. J. Fletcher Moulton, J. D. Matthews, and B. Pite, "Ancient Lights."

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Prof. C. Bendall, "Notes on a Recent Tour in Nepal and India."

Medical, 11, Chandos-street, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. A. T. Schofield, "The Springs of Character."

Tuesday, March 20...Royal Institution, Albemarle-str W., 3 p.m. Prof. E. Ray Lankester, "The Str ture and Classification of Fishes." (Lecture X

Civil Engineers, 25, Great George-street, S.W p.m.

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. M Rosa M. Barrett, "The Treatment of Juve Offenders, together with Statistics of their Nu bers." (Howard Medal Prize Essay.)

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p (Photo-Mechanical Meeting), Mr. Ignatz Herbe Demonstration of "The Heliogravure Process.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. S. L. Hinde, "Field-notes on some of the E African Mammals." 2. Mr. W. Bateson, "A C of Homœosis in *Asellus*—Antennule replaced b Mandible." 3. Mr. F. P. Bedford, "Echinode from Singapore and Malacca."

Wednesday, March 21...SOCIETY OF ARTS, John-str Adelphi, W.C., 8 p.m. Dr. Samuel Rideal, " Use and Abuse of Food Preservatives."

Meteorological, 25, Great George-street, S. 7½ p.m. 1. Mr. W. H. Dines, "The Ether Su shine Recorder." 2. Capt. M. W. C. Hepwor "Remarks on the Weather Conditions of Steamship Track between Fiji and Hawaii." Mr. Alexander B. MacDowall, "Comparison means of Dots."

Geological, Burlington-house, W., 8 p.m.

Sanitary Inst., 74A, Margaret-street, W., 5 p.m.

Microscopical, 20, Hanover-square, W., 7½ p. Mr. C. F. Rousselet, "An Exhibition of Sli of New, Rare, and Foreign Rotifera."

Archæological Association, 32, Sackville-street, V 8 p.m.

Thursday, March 22.. Royal, Burlington-house, W., 4½ p.

Antiquaries, Burlington-house, W., 8½ p.m.

Mechanical Engineers, Storey's-gate, St. James park, S.W., 8 p.m. 1. Adjourned discussion papers by Mr. Ernest Samuelson, "Improveme in the Longworth Power-hammer," and by M Ewart C. Amos, on "Portable Pneumatic Tool 2. Mr. Bryan Donkin, "Observations on Improved Glass Revealer, for Studying Co densation in Steam-engine Cylinders and Rend ing the Effects Visible."

Royal Institution, Albemarle-street, W., 3 p. Mr. H. J. Mackinder, "Equatorial East Afr and Mount Kenya." (Lecture I.)

Electrical Engineers, 25, Great George-street, S.V 8 p.m. Mr. E. J. Wade, "Storage Batt Problems."

Camera Club, Charing-cross-road, W.C., 8½ p. Mr. H. C. Donovan, "Phrenological Scienc Theory and Practice."

Friday, March 23...Royal Institution, Albemarle-street, V 8 p.m. Weekly Meeting, 9 p.m. Sir Andr Noble, "Some Modern Explosives."

North-East Coast Institute of Engineers a Shipbuilders, South Shields, 6 p.m.

Sanitary Inst., 74A, Margaret-street, W., 8 p. Mr. W. Hunting, "Signs of Health and Dise in Animals Destined for Food."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlingto house, 5 p.m. 1. Prof. S. P. Thompson, " Electromagnetic Experiment." 2. Mr. P. Shaw, "Some Experiments illustrating Synton 3. Mr. P. E. Shaw, "An Electrical Micromete

Saturday, March 24...Botanic, Inner Circle, Regent park, N.W., ¾ p.m.

Royal Institution, Albemarle-street, W., 3 p. Lord Rayleigh, "Polarized Light." (Lecture II

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FRIDAY, MARCH 23, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 19th inst., Mr. E. [S]ANGER SHEPHERD delivered the third lecture [of] his course on "Photography of Colour."

The lectures will be published in the *Journal* during the summer recess.

THE ALBERT MEDAL.

The Council will proceed to consider the [a]ward of the Albert Medal for 1900 early in [M]ay next, and they, therefore, invite members [of] the Society to forward to the Secretary, on [or] before the 7th of April, the names of such [m]en of high distinction as they may think [wo]rthy of this honour. The medal was struck [to] reward "distinguished merit in promoting [A]rts, Manufactures, or Commerce," and has [be]en awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill [C]ooke and Professor (afterwards Sir) Charles Wheat[st]one, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, [LL].D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of [th]e Institute of France, For. Memb. R.S., Chevalier [of] the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, [M]ember of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, [K].C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, [F.]R.S.

In 1873, to Michel Eugène Chevreul, For. Memb. [R].S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, [D].C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (now Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For. Mem. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (now Lord Masham).

In 1887, to HER MAJESTY THE QUEEN.

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S.

In 1899, to Sir William Crookes, F.R.S.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, March 13, 1900; SIR GEORGE BIRDWOOD, K.C.I.E., C.S.I., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said Mr. Lasenby Liberty had once before favoured the Applied Art Section of the Society with a paper—that was in 1890—and on the subject of "The Industrial Arts and Manufactures of Japan," and it was most kind of him, considering the heavy pressure of his responsibilities in connection with his well and widely known business in Regent-street, and of his official duties in Buckinghamshire, to again

favour us this evening with another paper, this time on "English Furniture." Mr. Lasenby Liberty's name was known over all the world in connection with furnishing and household decoration, in which division of sumptuary trade no man of our generation has more prospered. But the only point of interest in Mr. Lasenby Liberty's commercial success for us was that it had been achieved on artistic lines. Mr. Lasenby Liberty was one of the distinguished men of business in London who had identified themselves by natural instinct and reasoned conviction with the revival of industrial art during the great Victorian era. He was a man of keen commercial discernment, and sound, masculine taste in every department of applied art; and while doing full justice to his trade, and never neglecting its interest and advantage, he had devoted himself with unstinted, and, he might say, insatiable energy to the development of the artistic, as distinguished from the commercial side of his business; his predominating purpose throughout having been to seek through simplifying—and that in cost as well as in style—to beautify and dignify all the material accessories of our characteristic English home life. The national results of his discreetly enthusiastic enterprise have been the establishment at Merton of a High School of Art, perfected in all the methods and appliances of furnishing and household decoration, the resuscitation of the moribund British trade of silk weaving, and the bringing within the reach of the humblest of the middle classes throughout the United Kingdom of the refining, elevating, and in every way humanising influences of artistic homes, at least as regards their internal decoration. The Chairman concluded by reading an extract from a letter from the Earl of Carlisle, expressing his Lordship's great regret at not being able to avail himself of the opportunity of publicly attesting his appreciation of the valuable work which Mr. Lasenby Liberty had done in popularising good designs in furniture and rendering beautiful decorative materials accessible to every one in London.

The paper read was—

ENGLISH FURNITURE.

By Lasenby Liberty, J.P.

On a subject so well-worn as that of furniture, it would be difficult, even in a brief paper like the present, to avoid going over ground that has not already been more or less completely surveyed, and I must therefore disclaim at the outset any pretension of setting forth anything that is particularly original, or of dealing with the subject of English furniture, save from an evolutionary point of view. By way of conclusion to a general survey of the subject, I would first glance therefore on the rel tions of history to furniture, and second general principles of design and constructio with some indications of what I venture consider should be the direction and tenden of our aims in regard to English furniture the futnre.

Like all the other industrial arts, t making of furniture had its origin in t ministering to physical and social need The more lethargic races of primitive ma influenced by climatic conditions, would content to sit on the ground, and the i vention of woven mats and afterwards carpets, as in Asia, would be the natur outcome of such a habit; but the mo active races inhabiting colder climates, su as that of Europe, would find that sitting a stone or block of wood would be more co venient and save time. The weight and dif culty of handling the block no doubt suggest the stool, and the development of the ch from this by adding a support for the ba is sufficiently obvious. From the chair w derived the settle, which in time produc the couch and sofa. It is needless, course, to enlarge on this part of the subje since the evolution from the simple to t complex is a natural physical law; I woul however, point out that to this day Orienta manage to get along very well with scarce any furniture properly so-called, while th floor coverings have been justly celebrat from a remote antiquity. The Western natior on the other hand, had brought the art furniture manufacture to a high state of pe fection when it was still the custom to str the floor with rushes.

As the history of ornament is the histo of the human race, furniture must ha been the subject of decorative treatme in the remotest times, and whether we e amine the actual specimens which ha come down to us from antiquity, or conte plate their representations in wall-paintin sculpture, or pottery, we can satisfy ou selves that the ancients were skil designers and workmen in this branch industry. Egypt, which is claimed to be t cradle of civilisation and the arts, had, is well known, great influence both Assyrian and on Greek art, and in this co nection it is curious to note how unfavoura the work of the sensuous Asiatics compa with the restrained but graceful refineme developed by the Greeks, though, at the sa time, it lacks the symbolism and severe a

rfectly decorative treatment of its prototype. ›man furniture in the earlier times of the ›public appears to have been of a rude and nple character, befitting the habits of a litary commonwealth, but during the later ›public, and under the Emperors, the luxury d extravagance of every phase of social life ıs reflected in the furniture. Cicero, who nnot be justly accused of being a corrupt or rticularly ostentatious citizen, gave £9,000 r a table made of rare African wood, and a ble which had been the property of the con- ıered King of Numidia realised £10,000 at ıction. One feature of ancient furniture was e frequent employment of marble, ivory, onze, and, in the case of the later Roman riod, still more precious materials in its manu- cture. Thus we read of tables of lapis zuli, with legs of solid gold. This reckless odigality had its natural consequence, and oman furniture in its form and decoration, ough extremely rich and magnificent, never tained to the real beauty of the Greek.

The overthrow of the Western Empire ınished the arts from Europe, except that ›rtion under the Greek Emperors, and, in ›nsequence, very few examples of decorative ırniture appear in records of the Dark Ages Western Europe, and it is at least probable ıat the bronze chair of Dagobert, the silver bles of Charlemagne, and some other examples lustrated in illuminated manuscripts, were ıe work of craftsmen imported from the near ast. South of the Alps and the Pyrenees vilisation was not so utterly submerged for ıy great length of time by the wave of Gothic ›nquest. Intercourse with the Levant, and ıe remains of the old models preserved, at ıy rate, the tradition of better things, but the orth-Western nations remained in a state of bject barbarism, relieved only by the short ut brilliant period of Celtic art in Ireland and orthumbria. By slow degrees, as the Gothic tates improved in their law and order, the rts of life began again to receive attention, ntil towards the end of the 11th century the rusades, which have seldom been given their ue in this respect. The Crusades acted as an normous stimulus to civilisation in general, nd to art in particular. For those among the hivalrous hosts who returned alive to their omes, scattered all over Europe, brought back ith them some knowledge of the art of the ear East, and the pointed arch, the grouped olumn, and the carved capital, suggested by yzantine and Saracenic architecture. These ıodified by religious and climatic peculiarities, transformed the heavy Norman or Romanesque architecture of the West. In the hands of races who were freemen and warriors, devout and superstitious, but with a strong sense of humour, Christian art thus ran its course for several centuries, and left indelible marks on the art history of the human race.

The baron's castle, built and equipped mainly for defence, became the military and political centre of society, but the cathedral, the church, and the monastery were emphatically the centres of social and artistic life, and we, therefore, find this period Christian in its art for both ecclesiastical and domestic purposes. For the first time since the days of the Pharoahs, symbolism became the distinguishing feature of ornament, and as the grotesque may be regarded as being to art what wit is to literature, the humour of the people found its expression in it, as their religious feelings did in their symbolism. The life of the baron, spent in war and the chase, was not conducive either to luxury or beauty in furniture, and simplicity and rudeness were still further the result of the life in common led by the lord and his retainers, who for centuries kept the custom of dining all together in the hall, the baron and his family and immediate friends on the daïs. The rough table or "board," as it was then appropriately called, formed of planks laid on trestles, with long forms or benches for seats, often ornamented by carving, which were cleared away after the meal, must therefore have nearly completed the list of furniture in the hall. The private apartments, except those appropriated to the ladies of the household, were mere sleeping hutches. The ladies' rooms, of course, contained furniture of more pretension in the shape of bedsteads, coffers for linen and wearing apparel, smaller tables and seats. These last, however, were still benches or stools, chairs (often to seat two persons) being reserved for the use of the baron and lady as heads of the household. Couches and sofas were of much later introduction. It is curious to notice that even late in the 16th century the chair was still regarded as the appanage of the person of highest consideration, one only being used in hall, and it has been suggested that this circumstance is the origin of the term we use "to take the chair."

The sacred nature of the monastic buildings gave them immunity from attack; there was consequently greater security for the property contained therein; the lives of the monks were largely sedentary, which made

them appreciate indoor comfort; above all they had leisure to devote themselves to peaceful avocations, and possessed the monopoly of education. All these causes combined to make the religious houses havens where the arts could take refuge, and in consequence the furniture and household effects of the monks were generally of a superior order to those of laymen of equal or even of superior means. The sarcastic allusions in prose and in verse, and the satires *in wood*, levelled against the luxury and ostentation of the religious orders during the Middle Ages sufficiently attest the fact. The furniture, though often richly carved, always strongly made and well-proportioned, was still, however, uncompromisingly wooden; there was little or nothing of the comfort derived from what we call upholstery. Cushions, until the 16th century, were few and scanty; a log of wood hollowed out served for a bolster, and a bed pillow of chaff was thought luxurious. Still the 14th and early 15th centuries are justly looked upon as periods of splendour in the applied arts. The furniture of our cathedrals which has come down to us, such as coffers, episcopal thrones, sedilia, rood-screens, and altar tables, was worthy of these fine buildings. The faults of the woodwork in question are a too great influence of the stonemason, a failure to perceive the limitations of wood as a material, and a certain cumbrousness which, though appropriate in furniture intended in those days to be seldom moved, renders these pieces unsuitable for reproduction for modern requirements.

Whether the decay of the best traditions of Gothic art was due to a natural decline, or was hastened by exterior influence is a moot point. It is sufficient to note that its decadence coincided with the commencement of the Renaissance.

The republics of Northern Italy, Venice, Florence, and Genoa especially, by their trade with the Levant, had become exceedingly rich and powerful by the commencement of the 15th century, and the patronage of learning and the fine arts among the upper classes had already become a fashion, almost a mania. The capture of Constantinople by the Turks in 1453 and the consequent dispersion of many of the Greek inhabitants, who fled into Italy with manuscripts, medals, gems, and statues, may be said to have inaugurated the revival of classical learning and taste. The refugees were eagerly welcomed. The men who had been working after the tradition of Cimabue and Giotto at once perceived the superiority of antique art in realism, and the beauty which appeals to the senses, which came as a revelation. The classic in architecture was followed of course by the classic in interior fittings, furniture, and decoration, and in a few years Italy produced works which have been generally regarded as *chefs d'œuvres* of the woodworkers' art.

In France the new movement was delayed for a time partly by the effects of the terrible Hundred Years' War, and partly by the stern and gloomy policy of Louis XI.; but the expeditions of Charles VIII. and Louis XII. into Italy brought about the beginnings of the French Renaissance by Italian designers and workmen being invited into France by the King and nobles. It was, however, reserved for Francis I. to commence that era of ultra magnificence in architecture and the subsidiary arts which, with certain interruptions, has lasted in that country to the present day. The French and Italians, both ingenious peoples endowed with great manual dexterity and invention, and fond of novelty, raised the household furniture and fittings of the Renaissance to the highest pitch of ornate grandeur. The wood used was principally walnut, which of fine grain and easily cut and worked, lent itself with, perhaps, too great facility to the over elaboration so characteristic of the Latin races. Though, again, too stone-like and architectural in design, the early furniture work of the period was in many respects excellent, the construction good, on generally sound lines, pleasing in proportion and outline, and the carving, though florid, appropriate to its place and executed with both delicacy and dignity; and it is to be noted that French furniture during the period of the true Renaissance, in spite of occasional extravagances, never transgressed against good taste to the extent in which Italian work ran riot. The Flemings, the Dutch, and the Germans developed a Renaissance furniture of their own, which while possessing the characteristics of good construction and directness of purpose in a high degree, never aimed at the richness of design, or attained the refinement of detail found in the best French and Italian work.

The Renaissance was late in England. While Italy, under Lorenzo the Magnificent and his son, Leo X., and France, under Francis I., had established an era of unexampled grandeur in every kind of art, at once learned and inspired, the English were content to graft on the then existing debased

thic forms, clumsy classic detail, without preciation or understanding. The causes of s are not very difficult to discover. The ars of the Roses had swept away almost all old nobility, and those who remained were ich impoverished. The revenue of the Sovegn was limited by the Commons, and the eat middle class was not yet in existence, at least was only just coming into being. e unlimited resources of the absolute narchs of France and Italy were not availle in this country, and art whether in the ise of pictures or furniture cannot flourish thout patronage. Henry VIII., who, hower, had a greater ambition to rival the French ng than to foster art in his dominions, rdinal Wolsey, and some of the new nobility pear to have done their best to encourage new taste, and there are some pieces of naissance furniture of high excellence in our iseums and in private collections of the first lf of the 16th century. Though labelled English" it is more than doubtful whether ese were made in this country. If they were ey were most probably executed by foreign aftsmen. It is difficult to believe that the me men who made these pieces of furniture rked the heavy semi-Gothic fitments and nery of the period which still exist *in situ*.

The long reign of Elizabeth saw the rise of a al English Renaissance, which, while reining signs of Gothic influence, was yet sed on classic models, and withal exhibited its of a distinctly national character. The owing wealth of the country, which enabled eat nobles like the Earl of Leicester to keep households of princely proportions, and the e of the opulent merchants of London and istol, alike gave an impetus to the imrtation of fine models and skilled workmen, d to home design and manufacture. The ry wealthy, probably still by purchase from road or by the employment of Italians and enchmen, furnished their homes with carved alnut, with ebony and ivory; but the well-to- middle-class used the native English oak, ich, in the hands of English workmen, took a stinctive character of its own. Incapable of e clean cutting and exquisite finish attained working the finer woods, it yet was far perior for producing broad effects and assive outline. The nature of the material used restraint in the employment of carving, d the result was seen in the development of more truly decorative treatment than in her contemporary work. The exuberance of rid ornament, which broke out in this style towards the end of the 16th century, in sympathy with the debasement of the Renaissance in France and Italy, did not extend to any great lengths in the characteristic oak furniture of the period.

Beginning with the reign of Henry VIII. this epoch saw a great increase in the number of different articles of furniture manufactured. The custom of dining in hall fell into desuetude in spite of the protests of the Church and of the old school of laymen. At first the daïs was partially curtained off, then screened, and finally became a distinct parlour (or room for conversation), or withdrawing-room. As the number of separate chambers became greater, furniture was made on a smaller scale and in more numerous pieces. In the private apartments chairs took the place of stools and benches; these were not yet stuffed, but loose cushions were much used. Sofas were still unknown. The plate cupboard, as its name implies, was not enclosed, but an arrangement of shelves fixed to the wall, and garnished with silver and pewter cups and flagons. An ordinary table stood below for drink and side dishes. The two together are the ancestors of the modern sideboard.

With the accession of James I., began what I venture to believe is the finest period of our national taste in furniture. The return of Inigo Jones from his visit to Italy, and his appointment as king's architect, marks the commencement of an epoch in England, which but for the Civil War and the subsequent austerities of the Puritan *régime* might have been more truly worthy in art, and, perhaps, not less renowned than the period of Francis I. in France. James I. was a born builder and quite appreciated the talents of his great architect, but Charles I. more especially possessed a refinement of taste and a love of the beautiful almost unique among the prominent personages of his time. His Queen, as became a daughter of the Medici, was a munificent patron of art, and the Sovereigns who entertained and honoured Rubens and Vandyck, and took part in the masques of Jonson and Carew, must be allowed to have beneficially influenced the art development of this country.

It is not too much to say that the price of our liberties then achieved was the loss for the time being of our place as an artistic people. For more than a hundred years after the Civil War England cannot be said to have possessed a style or even a taste in furniture, in decoration,

or indeed in anything else of the nature of art. During the *régime* of the Commonwealth sculpture and painting were regarded as savouring of idolatry, and as everything pleasing to the eye was considered as sinful in itself, it is not to be wondered at that no encouragement was given by the dominant faction to the production of artistic and beautiful furniture.

This circumstance shows that religion has had a further influence on our national taste apart from supplying ornament with objects for symbolism. A shorn ritual and a gloomy creed have their reflex in the applied arts. Our climate also has exercised a potent influence on the taste shown in household surroundings; and the gilding, marble, carving in high relief, and general glitter and brilliancy of the schools of decoration emanating from the south of Europe, have been found incompatible with a climate which necessitates a more indoor life, and consequently has produced a land of *homes*.

These circumstances, combined with the freedom of our institutions, which enabled the people to curb the extravagance of their rulers, as I have previously noted, have been answerable for the fact that in every age the English taste has had a tendency to severity and simplicity, even when through political or dynastic alliances it has been most strongly influenced by a more elaborate and ornate style of decoration.

The Restoration brought a general relaxation from the austerity of the Puritan rule, but its effects on the decorative arts was little short of disastrous. The debased Renaissance of the period of Louis XIV. became the fashion at Whitehall and Hampton Court, and some of the furniture still shown at the latter palace proves that in spite of considerable influence exercised on English fashion by Dutch models during the reign of William III. the French mode continued to hold its sway in England. During the latter part of the reign of Louis XIV. it became more and more debased, until it culminated in the unspeakable rococo of the Regency and Louis XV.

This time of decadence, however, had its compensations, inasmuch as the age which gave us Christopher Wren and Grinling Gibbons must be allowed to have been a brilliant period in art of a certain type. St. Paul's is not only a masterpiece of proportion and scale, but a mine of wealth to the designer for the study of classic detail. I may mention, in passing, as a fact fairly well known, that the so-called Queen Anne furniture and fittings twenty odd years ago was really based some mantel and other fittings executed duri the reign of George I., and never had a claim to be called the revival of a style.

Though, in my opinion, the furniture of t period of Louis XV. is the worst of any reco nised style or school of decoration, yet brought out the powers of a most wonder group of cabinet-makers and workers ormolu. To a technical eye, many of the pieces show difficulties overcome by sh manual dexterity and skill, which have ne been surpassed, so much so that one is amaz to think how such workmen came by su designs—designs in which every principle good construction was set at defiance, a every canon of artistic truth violated, the o lines consisting wholly of curves without single straight line to give an appearance rigidity and strength. False in concepti and meretricious in ornament, it was a faith reflex of an artificial and corrupt age.

But now arose a group of English cabin makers, who in some degree raised their cr out of the rut in which it had long been content travel. Bad as the French styles had been, t English had made them even worse in proce of copying, for they could not reproduce th exquisite finish. The work of Chippendale a his compeers, though far from perfect, or ev of a high degree of merit, was undoubtedly great advance on what had preceded it. was the work of first-rate craftsmen, but of i different designers. The chimney and cons glass frames were direct copies, except regards general outline, of French work; t tables and cabinets a bizarre mixture of t same style with Chinese and Gothic! T chairs were undoubtedly the best of the wo in question, though even here the backs, w their meaningless carved ribbons and sh ornament, detract in many instances from th merit. Still the principles of good design w partly recognised, and they certainly paved t way for further progress. The style of deco tion and furniture introduced about this ti by the Brothers Adam, had immediate a widespread results for good. Whether spired or not by the fashion in decoration the same period in France, and known as Lo Seize, or whether there was a mutual oblig tion, we can note once more that English ta beneficently stripped the French decoration much of its over richness of ornament. T "Adams" is the most delicate and refined all styles founded on the classic, and never e

the side of ostentation or vulgarity. Its ra-delicacy indeed often degenerated into a d and feeble refinement, which rendered it 1-effective for wall and ceiling decoration, : its inspiration of the work of Hepplewhite 1 Sheraton is what mainly concerns us in a per on Furniture.

\s I purpose returning to this part of the)ject, I will pass on very rapidly to consider : reason why from the time of Sheraton there is such a universal degradation of all the plied arts in England during the first half of : 19th century. The great poverty and dis- ss caused by the long Napoleonic war, as o the political unrest which almost resulted a rebellion, may be mentioned as factors in s, but the principal reason was the enormous velopment of the machine industry, which ught in its train a rampant utilitarianism. e state of artistic industry in this country s at the lowest point of degradation ring these years. As furniture and deco- ion were no longer objects of beauty, patrons (apart from collectors) could y gratify their taste by the purchase pictures. Painting at this period was nonymous with art, and the age of rner and Constable, of Wilkie and Etty duced furniture, the designs for which, seen in old catalogues, are veritable night- res. The dry bones, however, began to be red, and Pugin and his coadjutors, by nging about the Gothic revival, began what must hope to be a lasting improvement in : public taste. It is true that what Pugin complished was a mere galvanising of the ad mediævalism which is impossible with dern conditions of life, but the revolt led against the abominations of the time s invaluable. He cannot be justly called great architect, but he accomplished what great architect might have failed to do. e Gothic domestic furniture produced dur- ; the period from the rebuilding of the lace at Westminster to that of the New w Courts, which I take to be the time covered the Gothic revival, though cumbrous, nerally over elaborate, and expensive, at y rate brought us back to the first prin- les of construction and directness of design. The Great Exhibition of 1851, though shew- ; some improvement here and there on : furniture produced in the thirties, was d before the new movement had had time be of much effect, and to judge by the illus- tions of it which are now accessible, the niture and fittings shown had the common fault of nearly all exhibition pieces, of needless elaboration combined with poverty of design. Since the Gothic revival died its death, the history of furniture in England was for many years nothing but a series of ill-considered revivals of a miscellaneous past. It is cheering, however, to see that, having run through a cycle of copying and combining, our designers are beginning to invent by evolution from classic models. To be successful this must be warily done with a reverent eye on the past, and without attempting to avoid the common- place by rushing into the vulgarity of the bizarre and eccentric.

I do not mean that designers should allow themselves to be too much hampered by pre- scription and tradition, but that the examples of the best periods should always be kept in view, and the principles which underlie those examples firmly held.

If I have understood aright the teachings of the great art critic and teacher who has just passed away, I should say that our text and motto in furniture manufacture, as in every other of the arts of life, should be utility before all, but æsthetic utility. Furniture is not made primarily to be looked at but to be used. Better a Windsor chair with comfort than a *chaise à la Louis Quinze* which makes one's back ache. Let every part have its meaning and fulfil its purpose. Doors that will open and shut, drawers that will work smoothly, handles that can be held—truisms if you will, but truisms not always recognised in practice. Utility, which means fitness, is in itself beauty if rightly understood, but man being born of woman is under an inherent necessity to decorate. The plainest piece of furniture devoted to the humblest office can properly receive ornament of some kind. A heavy kitchen table or dresser with a 2-inch top can be made to look lighter and more pleasing by a simple bead or chamfer without weakening the construction in appear- ance or reality, but decoration should never be purposely constructed. Form, by which I mean the general outline of a piece of furniture, should be always perfect in itself, and should primarily be independent of decoration, and if the cabinet, the table, or the chair does not look well before the ornament is added no ornament subsequently applied will correct the first error. Good outline and good proportion are both necessary to produce excellence in form, and in good proportion there should always be a dominant mass to which the other parts are subsidiary, and to which the eye con- stantly returns. It is needless to say how all

great painters, architects, and designers have kept this principle in view. The subsidiary parts again should constantly vary (not too sharply, for the more subtle the proportions the more pleasing), for the whole art of composing or putting together the several parts consists in varying well and intelligently. It is quite true that composition cannot be taught. Ruskin has well observed that one may as well endeavour to teach how to be witty; but this can be learned, that there are certain rules which have never been violated by the great masters of design, and these afford tests by which good work can be known and appreciated. Closely connected with the theory of good proportion and form are those principles of sound construction which have obtained in every good period of art, and which are not difficult to learn from the examples of the past. The proper main lines for good woodwork are the perpendicular and the horizontal. The curved line is only admissible as an adjunct to these, and should always be subordinate. An unornamented piece of furniture composed wholly of straight lines may be yet quite satisfactory to the eye, but one entirely composed of curves can never be so, though decorated with the utmost skill and refinement of detail. It is an axiom of good construction that whatever the material used it should be as far as possible homogeneous, and in the case of woodwork recourse should be had as little as possible to metal and glue. In a damp climate especially, screws and iron straps and angle irons rust, and glue softens and decays. The tenon and mortise, the dovetail, and the other real joints should be relied on. Each surface should absolutely fit, so that the least possible film of glue be employed. Not only are the joints necessarily stronger, but the glue is more effectually protected from the air. Too great a use is made by cabinet-makers, especially in chair frames, of the dowel, which is always a weak joint in comparison, though it is true that they are sometimes driven to its use by bad designs. I may also mention that dovetails are nearly always made with too great a slope, which weakens the cross strain without increasing the lateral strength of the joint. Pins through tenons should always be of wood.

The abuse of mouldings is a fruitful source of failure to produce good woodwork. A surface of plain wood of large size must necessarily not only have a bare and uninteresting appearance, but be liable to warp and split under differences of heat and moisture, and for this defect the invention of the panel was an obviou remedy.

The square edge of the framing "stile,' it was found, made too abrupt a transitio with the panel, and the chamfer was the result This grew afterwards into the moulding, b breaking the material from one level to th other, by a series of rounds and hollows, &c In strictness, therefore, the level of the mould ing should not rise above the stile. To rigidl observe a hard and fast rule of this kind however, would be pedantic, and like man other general maxims can sometimes b violated with advantage, a projecting mouldin when intelligently employed often giving vigou and character, especially in work on a larg scale. When not kept within due bound however, the effect is often deplorable. Som Italian and French and even German wor exists, and has been copied of late years i this country, where every detail is overpowere by the moulding, which being of excessive widt and height form panels bewildering in the number and the oddity of their shapes, until th absurdity reached a climax in certain joine work produced a few years ago, in which th mouldings were fixed, crossing the pane saltire-wise, from corner to corner. Moulding employed on the shelf and cornice are in different category, their use being, of cours to lighten the effect of a thick square edg Even here, however, we often see the effe frittered away by excess of carving, and som times by a violation of the rule that every og curved member of the moulding, whether og or ovole, should have its angle to balance In work of the best schools mouldings are ve slightly carved, if at all.

The art of the carver being nearly allied that of the sculptor, and, therefore, standi on a higher plane than that of the other craf man connected with working in wood, h always had a tendency to transgress its d bounds, and to assert itself in a manner i compatible with its proper sphere of m decoration.

The desire of the artist to display his skill fine modelling and cutting, and his knowled of anatomy and of various styles of ornamen has constantly been productive of resu which, though gratifying to himself and p haps to his patrons at the time, have been fa to the true artistic balance of effect in t piece of furniture so decorated. Some of t ornate cabinets, tables, and chairs, produc by the Italians during the past three centuri have more the appearance of strange a

onderful specimens of carving than the individual and useful pieces of furniture whose ımes they bear. The ornament is everything, e usefulness as furniture nothing, and this I ke to be about the worst that can be said of ıy thing of which the chief object is utility.

The French and Germans, and, indeed, ery nation, have also been sinners in this spect, though much less so than the Italians. With regard to carving generally, and with e proviso that hardly any rule in art is so rict but that circumstances may sometimes stify its being broken, I should say that the ws which govern it in its relation to furniture e that high relief should be reserved for porons already in relief from the main mass, ıch as columns, pilasters, table legs, &c., ıd that even here the ornament should never terfere with the proper contour and main ıtline, and that panels and all flat surfaces, hen carved, should be only in very low relief. it be desired to display a fine piece of work high relief in a pediment or a panel, then e latter should be sunk, and should be of rge dimensions, so that the height of the ırving be counterbalanced by the breadth of e work. I have no need to enlarge on that ı which every one is now agreed, viz., on the udious avoidance of such abominations as ere produced 50 years ago. A sideboard pported by laboriously carved spread eagles, a table with carved dolphins for legs, like e notorious dumb waiters in Trafalgaruare; but I would point out that a ıall panel with an equisitely carved group ojecting far beyond the level of the stile ıme, such as we see in really fine work of the alian Renaissance, shows the necessity of eping the artist workman strictly to heel, en in a good period of art.

A good deal of what I have just said is true marquetry, though I am not one of those ıo regard this as illegitimate decoration. In sense, of course, it *is* a sham, but, at e same time, it proclaims itself so frankly be what it is that no one is deceived, and obably nobody ever thought he was looking a mosaic of variously coloured woods, cut ıd pieced together in the solid. Still, inlay all kinds ought to be strictly kept within ounds. Like carving, it is a good servant but bad master. The enthusiasm of the specialist proverbial. There is nothing like leather in e opinion of the cobbler, and there seems to an inherent tendency in every trade and craft assert itself unduly. We can see what the lay cutter is capable of when allowed to get out of hand by examining some of the old marquetery of the 17th and 18th centuries, where the cabinet, bedstead, chest of drawers, clock case, and the like appear to have been made for the express purpose of showing what he could do, and certainly he did some wonderful and terrible things. Good marquetry is subdued in tone and without violent contrasts in colour, always conventional, or at the most semi-conventional in character, and, above all, never attempts to suggest *a picture*. With some hesitation I may also, perhaps, be allowed to add that it is like the garlic in a salad—a little goes a long way. In anything I have said by way of criticism I must not be understood as decrying the arts of the carver and inlayer *per se*. The celebrated carved group at Chatsworth of the woodcock, lace handkerchief, &c., is in order as a *tour de force* and as a more or less satisfactory specimen of wood sculpture, though personally I would prefer the work of the unknown carver in the Boulâk Museum at Cairo; and an elaborately inlaid wood panel framed as a picture would be at least a legitimate method of displaying the craftsman's skill; but I protest against the use of such work as decoration for a piece of furniture.

Perhaps in this connection I may say a few words on the vexed question of machine-made ornament. The sweeping denunciations of it as an accursed thing which we are accustomed so often to hear, are, it seems to me, uncalled for and unreasonable. It is neither practicable nor desirable for us to go back to the 15th century, and the cry that all decoration not executed by hand is no decoration at all, is another illustration of the regrettable fact that the average man, when caught by a taking phrase, seldom or never stops to consider whether or not a proposition which on the face of it is sound enough, covers all the ground. It is overlooked that a strict rule of this kind would debar us from the use of all inexpensive paperhangings and textile fabrics, and that there are, indeed, few minor art productions which would be accessible to any but the wealthy, without the aid of labour-saving appliances of some sort. It is true that such a rule would be more applicable to ornament, as applied to furniture, than to most other art developments, though, even here, it should be confined to the production of ornamental carving of a high order, and which can only be satisfactorily executed by hand. When a continuous reproduction of egg and dart or other simple ornament on a moulding is neces-

sary to the effect, and the high cost of carving by hand is prohibitive, it is surely preferable that it should be cut by the carving machine than be omitted altogether. I need hardly say that I am quite in agreement with those who denounce such false work as wood embossed in imitation of more ambitious carving by pressure, or repoussé metal produced by the stamping machine; but these stand in a different position from ornament which is merely intended to vary a succession of straight lines and satisfy the eye without attracting it. In short, I consider that machinery can be satisfactorily employed in producing ornament of the humbler kind, and which is intended to be felt rather than observed.

Now a word on the use of varnish. For the protection of wood from the effects of damp and dust, and, still more, for bringing out the beauty and colour of the grain, varnishes of different kinds have been in use from very early times. For heavy furniture and fitments of oak, teak, &c., the old mixture of turpentine and wax is still unrivalled, while for fine cabinet work the more recently invented solution of shellac in spirit is used. This latter is one of those things which requires the most skilful manipulation, as when employed in excess, or without the utmost refinement and delicacy of finish, it easily becomes the acme of vulgarity. This naturally introduces the question of stain. Some purists have spoken and written very warmly on the subject, and have decried the use of stain altogether. "Rub the wood with a little oil, and so leave it to mellow by time," says in effect one authority. "It is a sham," says another, "to try to make new oak look as if it were antique." Now, I submit that we do not buy furniture, or have wood fittings put in our houses exclusively, or even primarily, for our heirs. Life is short, and, as a rule, many years elapse before wood puts on its final complexion. I submit, too, that in staining our oak brown, and in deepening the natural colour of our mahogany and satinwood, we are not necessarily attempting to make it look as if it were old, but only investing it with the richer tone of colour, which, without stain, we might never live to see, and to which even it might never attain. Of course, stain can be abused. To employ it to imitate inlay is the sham of a sham, and to invest wood with a colour which does not, and never can belong to it in the natural order of things, is also questionable, although I would, perhaps, make an exception in favour of some shades (green for instance), which, when intelligently employ with proper accessories in the way of deco tive surroundings, is capable of very sa factory results, *i.e.*, when the furniture executed mainly as fitments, as part of architectural features and joinery of the ro Painted and japanned furniture in colou rarely successful in Western work, since pigment never attains to sufficient depth richness, and the general consensus of opin I think rightly, has decided that a tint of cre slightly varying according to surroundings the only colour which can be satisfacto applied to moveable furniture, or to fitments *suite* with it. It certainly possesses advantage of lightness and elegance of eff and harmonises with practically any schem colour.

The relation of metal work to furniture one of the most fascinating branches of subject, partly because of the great inter of the work itself, and partly because in ages the metal mountings have afforded very complete test of the worthiness or oth wise of the art school to which the furnit has belonged. The characteristics of go metal work in this connection are, first, t it should fulfil a distinct purpose, which co not be fulfilled by the wood alone, seco that it shows such purpose plainly, and, thi that it should be good in itself. All go metal work as applied to furniture and ments does fulfil these conditions. The lo plates, keys, handles, hinges, bolts, &c., mediæval work are almost always excelle and the same with some qualification m be said of that of the best period of Renaissance. The debased French sty of the 18th century degraded metal to purpose of ornament pure and simple, a this not sparingly but to an absurdly excess degree, while every bit which was of use a answered any purpose was studiously kept ou sight. Hinges were made as small as possib and carefully hidden, lock plates were whitt down to an escutcheon to cover the keyho handles were often omitted altogether, key being the only means of pulling o the door or drawer, and when they were u they were made to look as unlike hand as possible. Some of the ormolu moun pieces of furniture of this period are models perverted ingenuity and skill. In the pres century, up to the Gothic revival, art me work could scarcely be said to exist in Engla but then the art of the smith once more ca into fashion, and there has been during

st fifty years a steady and continuous improvement of design, until an excellence has en reached equal if not superior to any in st times. Once more, however, a careful server is able to notice a tendency to overaboration, and we may see a small door th hinges and lock-plate, large and elabote out of all proportion to what is cessary, and drawer handle-plates almost ncealing the wood. It is not always perived that what would be perfectly suitable strengthening a set of old Flemish window utters, or a mediæval treasure chest, is out place on a modern sideboard. The smith ay be allowed to run to the end of his tether a gate, a grille, a fender, or a pair of dirons; but in the making of a piece of furnire he must learn that his work is to be subdinate to that of the joiner or the cabinetaker.

Time will not permit of my entering length into the subject of fabrics, which, en within the comparatively limited scope of eir application to furniture, might well fill a per; but apart from the ease and comfort ich the art of the upholsterer contributes to r lives, I would mention their great value, m an æsthetic point of view, for effects of lour and to soften outlines. The general provement in taste, which has characterised e art history of the past 30 years, has in no se been better exemplified than in the design d colouring of the textiles of the present y, as will be readily admitted by those who e old enough to remember the repps, poplins, nion damasks, and other furnishing materials a generation ago. There has been also a rresponding improvement in the handling of r furniture fabrics, and in the design of holsterers' trimmings.

A most important subject, and one I should ich like to have had time to emphasise, is at regarding the relative balance which ould be maintained as between furniture and ural decoration and hangings; but I must ntent myself with saying that as a rule rniture should stand out in contrast from ural treatment. That is to say, if the rniture is elaborate in design and full of oken colours, then walls should be in a onotone colouring and unbroken by any onounced design. On the contrary, if the lls are rich in design and colouring the rniture should be severe in form and of a onotone colour. Further, this holds good of individual piece of furniture, I mean that aborate detail and rich colour in any portion of it should be counterbalanced by comparative plainness elsewhere. I need not say that when I speak of contrast I do not imply contrast of style, for that of course should be homogeneous, or that such contrast should necessarily be strong, for harmonious treatment is generally far more satisfactory.

And now I will bring these desultory comments to a conclusion with a few remarks on what I think are the correct lines which should be followed by our designers in the future.

Obviously some common standard of excellence should be first recognised, not to be copied, or even perhaps closely imitated, but for what I would call the *motifs* for work in furniture. Our best periods, in fact the only periods when England developed a national art in the household, were those of the first half of the 17th and the latter half of the 18th centuries. Always keeping in view the character of the English climate, and the tastes and habits of the people, I consider the Jacobean combines in itself all the characteristics of a good style, and from its dignity and solidity is especially applicable to what may be called the masculine side of furnishing—the dining-room, hall, and library. At its best in oak, it can be worked successfully in walnut and teak, and is susceptible of the greatest variation in its treatment, from the richness and elaboration suited to the state apartments of a palace, to the degree of plainness and severity which accords with the surroundings of a farmhouse or cottage. When enriched with carving and good marquetry, and used in conjunction with gilded leathers or fine tapestry and handsome ceiling plaster, it is in the highest degree sumptuous and magnificent, and at the same time in a simple form, with that touch of the archaic which gives character and originality, it lends itself with equal facility to use with the humble wall-paper. The furniture and fitments of this period at Holland-house, at Knole, and in the South Kensington Museum are models from which it would be possible to form a truly national style in the future, not, as I have said before, by copying, but by a due observance of the principles underlying both the design and construction of the works in question. Allowing the widest latitude to individual taste—for I hold that good taste can be found equally among those whose predilections are in favour of richness and abundant ornament, and those who incline to the simple and severe—the examples I am recommending to be studied will furnish us

with rules both for keeping the highly ornate within proper limits, as well as for softening harshness and austerity.

The other period of which I have spoken, viz., that of "Adams" decoration, and Hepplewhite and Sheraton furniture, should be studied by designers for *motifs* of what I would call the feminine side of furnishing—the drawing-room and the boudoir, and its characteristics are lightness, elegance, and grace.

Hepplewhite may be considered a connecting link between Chippendale and Sheraton, his chairs, &c., being more refined than those of the older master, though not wholly free from their blemishes. Sheraton was an exceedingly able man, and was one of the best draughtsmen of his day, and, though himself a prolific manufacturer, very large quantities of furniture were made by contemporary cabinet-makers from his designs. Working mainly in mahogany and satinwood, his cabinets, chairs, tables, &c., though unequal in merit even in his best period (say from 1790 to 1800), are, for the most part, worthy of praise. The influence of the spurious classic of the Empire period in France caused, later on, a very remarkable falling off in his designs, some of which, produced in the early part of the century, are about as bad as they can be. During the time in which he continued under the influence of the Adams, however, he aimed, like them, at severe refinement rather than massiveness and fanciful ornament, and consequently made but slight use of carving. The cabriole chair and table legs of Chippendale were discarded altogether, and the heavy, square legs of the same maker he tapered with rare elegance of effect. The ornament was almost confined to inlay, and this is found almost invariably in keeping with the general design and aim of the furniture, as even in his most elaborate work it is subordinate to the main effect, while in the simpler pieces, by the judicious use of lines only, it is made to emphasise the construction. The details of the decoration are simple, and perhaps a little wanting in *verve*, but are admirably drawn, and are never stereotyped, each husk, loop, and festoon being varied according to the shape and size of the space to be covered.

The contemporary style of this period in France, the Louis Seize, was a vast improvement on the rococo of the preceding reign, inasmuch as it conformed to some of the more reasonable and obvious rules of construction, and the decoration, though nearly always overdone and often false in its application, ha[d] elegance and comparative severity very [re]freshing after what had gone before. W[hen] it is desired therefore to produce furnitur[e for] the drawing-room and boudoir of a distin[ctly] ornate character, the Louis Seize can [be] studied with profit by the designer. I w[ould] limit such study strictly to the ornam[ent,] as the general lines and construction [of] the Sheraton style can hardly be impro[ved] upon; indeed furniture can be made quite [un]mistakably Sheraton in character, without [any] ornament whatever.

According as our designers therefore ai[m at] dignity and massiveness, or lightness [and] grace, let them keep in view the work of t[hese] our best periods. Both styles are in rea[lity] allied, being founded on the classic; both [are] capable of much modification while retai[ning] their distinctive characteristics; both are [sound] and correct in construction; and, lastly, [they] are English—in the sense that, though evol[ved] from foreign models, they were adapted [not] crudely by copying, but intelligently, a[nd] being modified by national feeling [and] taste. It is surely not too much to h[ope] that in course of time we shall bec[ome] discontented with remaining in lead[ing-]strings, and with ringing the chan[ges] on the styles of the past, some of wh[ich] are utterly alien to our national sy[m]pathies and needs, and that the influence [of] these two allied forms of art will cause [the] opening up of future artistic possibilities [at] present unrealised.

If I may believe that by anything I h[ave] said to-night I have helped forward this consu[m]mation, I shall feel grateful to my colleag[ues] on the Committee of the Applied Art Sect[ion] who over-persuaded me to prepare this pap[er.]

DISCUSSION.

Dr. J. TODHUNTER said he thought the princi[ples] which Mr. Liberty had laid down were the t[rue] principles with regard to artistic decoration. [The] little history which he gave of the development [of] domestic decoration was extremely interesting, [and] he was especially interested in finding that he [had] what some people would consider the audacity [to] find fault with the Chippendale furniture, which so[me] years ago was made a sort of idol by those w[ho] wished to be artistic in furnishing their houses. [A] great deal of Chippendale work seemed to be v[ery] good, but some of it erred on the side of ov[er-]decoration and the abuse of classical form. T[he] Sheraton furniture had very much more of the t

assical spirit in it than a great deal of Chippendale. [e did not know whether Chippendale carried out ıost of the designs which appeared in some of his ooks, but, at any rate, some of the designs in those ooks were simply hideous. Perhaps before they ould have a perfect mode of furnishing and uphol-:ery they must develop domestic architecture, and btain a less eclectic style of architecture than they ad at present. This was gradually developing. The)ueen Anne style of architecture had possibilities efore it. It was becoming more of a late 19th century tyle of domestic architecture, which would probably e modified and developed in many ways which could ot quite be at present foreseen. A good deal of ery beautiful work had been done already in this tyle. The great fault in the decoration of rooms, eemed to be the heaping together of a number of hings which might be beautiful in themselves, but hich were often merely curious and expensive—in fact, ıaking a sort of museum of the drawing-room. This ᵹas ridiculous. The fault hitherto had been not ıerely want of selection, but want of any real rinciple which could be called true taste; that is to ay, it was very much better to err on the side of everity or even massiveness, than to heap together whole museum of objects, without having any eading principle of taste in the arrangement of them. Ie once met a Japanese gentleman in a modern lrawing-room, and upon asking him what he thought f the room, he replied, "We should call that very arbarous in Japan." There was a Morris paper, of very large pattern, covered with flowers, and the apanese, pointing to it, said, "We should only have ne flower." Even Morris, who did a great deal for lecoration, rather erred on the side of being too 'patterny" on the houses he furnished for other eople, though he did not err in this respect in his wn house. As they got a simpler taste in house urnishing, the over-elaborate patterns of wall apering would die a natural death. He had seen eautiful designs which, if produced in tapestry, vould have been very appropriate, but in wall papers, vhere they were treated on a flat surface, they were quite wrong in principle.

Mr. H. LONGDEN said there was one age of work to vhich Mr. Liberty had not referred much in English vork, which he thought was very admirable and vorth studying, namely, the work of the earlier part f the 18th century. The work of the latter part of he 18th century was very beautiful, Sheraton. Chippendale, and Hepplewhite were very delightful, out there was a boldness, and, at the same time, simplicity in the work of the earlier part of the 18th century which seemed to be a direction in which they should look. Of course, direct imitation of any by-gone style was not work which had any future before it. The only good work that could be done now was done by a study of work of former times, but not by reproduction—by taking the principles and adapting them for our present purpose. It seemed that our present requirement was leaving out ornament to a very great extent, and a return to greater simplicity, depending more on proportion and less upon ornament, There was no better model for such work than the work which could be seen at Wilton, and in a number of the houses where the work of the earlier 18th century was to be studied.

Mr. LEWIS F. DAY said he was rather taken by surprise by Mr. Liberty's paper; he had always looked upon him as an innovator, and admired him as such; and it appeared he was an upholder of classicism. However, he had preached sound doctrine, to most of which he, Mr. Day, subscribed. He did not quite agree with him on the point that Puritan influence was altogether against art. The national quality of our art which had been referred to was largely owing to a certain severity which did not characterise the work of neighbouring nations. That it was which kept us from the worst frivolities of the Rococo, and to this day English decorative art, in so far as it was better than other, was more earnest and more anxious. Some of the men who had done most for decorative art in England had been absolutely earnest men. A more earnest man could not be found than William Morris, and it was his earnestness which made for rightness in art. Mr. Liberty had referred to the evolution of design from classic models. He agreed that the design must be a sort of evolution from what had gone before, but, it seemed to him, we had to evolve our design always from the conditions of the case, and from the immediate needs of the day. Art had suffered by our not doing that enough. One way in which we had erred particularly was in following the architectural design of the Renaissance. He often wondered what our furniture would have been if cabinet-makers had not been led away by the architectural idea, and had been free to construct furniture without thinking of architectural elevations. He thought we might in that case have had something more reasonable, and yet quite as beautiful as what we had. One result of working upon architectural lines was the abuse of mouldings, useful in furniture mainly as dust-traps. *A propos* of what Mr. Liberty had said about inlay, he was rather inclined to think that inlay and marquetry were a more becoming form of furniture enrichment than carving, as they harboured less dust, and were more pleasant to pass the hand over. Some of the most satisfactory carving was so low in relief as to be more like engraving. To do away with mouldings would relieve us from the necessity of machine-carved mouldings. He did not quite approve, though he was glad to hear a word in favour of the much abused machine to which they owed so much. He did not quite see why the metal-worker might not now and then have a show in furniture. The metal work was usually subsidiary to the cabinet work, but in work which went deliberately beyond utility

he did not see why the smith should not have as free a hand as the carver. With reference to the remarks made by the last speakers about pattern and ornament, they were often much abused, but that was not the fault of the pattern, but of the wood that was used. The more ornament you had the more difficult it was to manage it, but a capable artist would not be afraid to use it. The present cry of going back to simplicity, and the absence of ornament, was rather the cry of the weak. It was so very safe to whitewash a wall. Simplicity was what every artist strove for, and what the best men reached, but there was simplicity and simplicity. He had seen modern furniture in exhibitions in which the simplicity of construction was an elaborate fraud. There was an affectation of simplicity which was quite as bad as the elaboration of which we had to complain in the past.

Mr. F. AUMONIER said he agreed with Mr. Liberty in thinking that the Adams style was thoroughly English, and produced a very beautiful effect in wall-paper. There was great advantage in simplicity, and he was satisfied that manufacturers were frequently driven to great expense to satisfy the inordinate craving for ornamentation that was evinced by the public generally. This was a great mistake. When a wall was lavishly decorated the furniture of the room should be of a simple character, and *vice versâ*. It was of the utmost importance that there should be a good quiet foil of some kind in the most beautifully decorated room, and no scheme of decoration was perfect unless there was such a foil as gave repose to the eye when looking from the rich part of the work to the simplest part.

The CHAIRMAN, in closing the discussion, said:—I was brought up without furniture; that is to say, I was born, and lived to my seventh year, and again from my twenty-first to my thirty-fifth year, in a country where the great art of furnishing is to do without it. In Western India, beyond the influence of the English-made towns, like Bombay, the Hindus have no furniture. One garment—a sort of wrap—suffices for the men, and one garment—also a sort of wrap—for the women, and a mat, or a cotton rug, for their bed. With a twist of the hand they can cast these garments from them, and equally easily take up their beds and walk away with them. A few pots serve for cooking and holding water. There are no dishes and plates, no chairs and tables, no curtains and carpets, but only the images of the gods, and the utensils for their worship, and the sacred books. So surrounded, and in such fashion, the masses of the up-country Hindus live their lives of simple joy with their household, and country side, and higher autochthonous deities: and recalling it all to mind, I feel a momentary disgust of the whole "Persian apparatus"—it is Babylonian really—of our modern European furniture, while at all times my personal preference is for a puritanical simplicity, not to say severity, in furniture; and I know, we all know, that Mr. Lasenby Liberty is at one with me in this, in spite of certain expressions in his paper. Nothing, indeed, could be more admirable than Mr. Lasenby Liberty's paper, alike in its logical arrangement and lucidity of expression, and the general principles of household decoration it illustrated and enforced. His history of the evolution of the chair was very interesting, and recalled Cowper's lines in "The Task," on the gradual development of the stool into chair, the settee, and the still Babylonian-named sofa [*i.e.*, *saffah*]. Describing the upholstery of these different denominations of seats, covered with splendid tapestry, green and blue, and yellow and red, richly woven, or embroidered, the poet adds:—

> "There might ye see the pæony spread wide,
> The full-blown rose, the shepherd and his lass,
> Lap-dog and lambkin with black, staring, eyes,
> And parrots with twin cherries in their beaks."

Those present who were old enough to remember chairs covered in this style, will derive pleasure through the awakening of slumbering memories, from the recital of these lines, but I quote them to emphasise the fact that an age distinguished for its good taste in furniture was still capable of the most shocking solecisms in its decoration. In short, in art, as in literature, and science, and war, and statesmanship, the individual was everything in the reckoning and the rank and file of the people, "classes" and "masses" alike, counted for next to nothing; and this was more especially true of the history of art in England, where while there had never from the time of the Tudor been any long break in the succession of decorative artists of the highest ability, many of them having been men of original genius, there was still no widespread artistic culture throughout the population. This went far to explain our frequent lapses into barbarism in such democratic departments of the applied arts, as furnishing and dressmaking. About thirty years ago the dress—"the Princess robe"—worn by ladies was most natural, becoming, and distinguished, and as about that time the influence of Mr. William Morris on household decoration was everywhere becoming observable, I began to hope that at last we were on the threshhold of a great and abiding revival of national taste over the whole United Kingdom. But a few years later some speculating dressmaker invented another dress, and at once the ladies indiscriminately took to it, and from then until now the costumes of our fashionable ladies has gone on changing from bad to worse, until a summer or two ago they reached the height of artificiality and outrageous vulgarity. Thus we were disillusioned of another Eden, and again it was the "Woman of the Period" who did it. Now the only really well-dressed women one meets are the hospital nurses, and I suppose it is because we doctors regulate their offici

-sses—" regimentals "—for them. Mr. Lasenby
berty had more than once reflected on what he
nsiders to be the evil influence of the Puritans
our domestic arts, but surely for the simplicity,
ace, and sweetness of their attiring, our English
lies of the Puritan period had never been ex-
led not even by the Grecian women of the age
Pericles. The Chairman added that he would
ve liked to say something in defence of "Chip-
ndale furniture," but there was no time for it,
d he therefore concluded by expressing the hope
at Mr. Lasenby Liberty would republish his
per as a book, illustrated by the examples of
niture and household decoration described by
n, and moving a vote of thanks to him.

Mrs. SPLATT said she wished to say a word in
fence of her sex, who had been accused of want of
ste, and, consequently, of having a want of influence
domestic decoration. She must disagree with that
ew, and, as an instance, would refer to the fact that
d it not been for the ladies the beautiful colours
d materials which Mr. Liberty had made world-
nowned, would hardly have been so at all. Women's
fluence on all art, domestic or otherwise, had in all
es been special, and, speaking from a purely
mestic point of view, her experiences of men's ideas
internal house decoration displayed a striking want
originality, not to say monotony, and had, as a
le, purely utilitarian aims, which, with many advan-
ges, had a certain lack of interest.

The lateness of the hour prevented Mr. LASENBY
BERTY from replying, but he has since sent the
llowing:—In regard to Mr. Longden's remarks
garding an early 18th century style which I omitted
review, I am not clear as to his meaning, unless it
the so called Queen Anne, but to this I made
ference, and I believe the instance he mentions,
Vilton-house, with the interior fittings of which I
n not acquainted, was replanned by Inigo Jones in
e Italian style of Whitehall. This points to
cobean fittings, if not furniture. But the house
as much altered and spoiled by James Wyatt, who
ed 1813, before the alterations were complete.
hen as to what was said regarding simplicity in
esign. This should doubtless be rigidly adhered to
all designers who feel their talents unequal to
ccessfully combining it with duly subordinated
nament; such designers as it were "play for
fety," though as Mr. Lewis Day says, they are in
nsequence very apt to be led into an effectation of
mplicity. I agree, too, with Mr. Lewis Day and
ir George Birdwood, that Puritan influence was
eneficial so far as it restrained the ornamental pro-
sion of the Louis Quatorze period and the frivol-
ies of the Rococo, but what I deplored was its
onoclastic tendencies and those sterile negations
hich checked all artistic growth; but Mr. Day's
troduction of the name of William Morris as an
ascetic and a Puritan in his feelings, seems most incongruous and particularly as an opponent of decoration. As Dr. Todhunter says, he was sometimes "too patterny." Then Mr. Day calls on us to invent a style. Architecture is the acknowledged mother of all the arts, and it is difficult to conceive the heaven born genius who shall invent furniture that is not evolved in some way from its maternal influence, though of course furniture should conform to the immediate needs of place and circumstances, and yet these surely must include considerations of architectural elevations. As for allowing the metal worker free play, this license should assuredly be restricted to useful or decorative objects, composed solely of metal, such as grills and irons and the like. In regard to upholstery, if Mr. Day means only to abolish stuffing seats and couches in excess, *i.e.*, beyond what is required for comfort, every one will agree with him. But if stuffing is to be disallowed to such an extent as to sacrifice comfort, its usefulness is sacrificed for the sake of appearance,—which I conceive is bad art. Then again the abolition of carving, except as mere engraving, is a question of taste rather than principle, though, doubtless, there are surfaces and positions on furniture where inlay is more convenient and therefore more appropriate, but to sacrifice all the beauty and interest of carving, because it harbours dust, seems to be a case of the remedy being worse than the disease. Dr. Todhunter is most right in saying that some paper-hangings and other mural decorations which are often used as backgrounds for pictures and furniture are too distractingly pronounced in design and colouring, and that they should only be used as decoration pure and simple; but this does not effect the principle of their use; truly good taste scarcely ever fails in its relative employment of materials.

SIXTEENTH ORDINARY MEETING.

Wednesday, March 21, 1900; OTTO HEHNER, F.I.C., F.C.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bolling, Randolph, Virginia Iron, Coal, and Coke Company, Bristol, Tennessee, U.S.A.
Brain, Herbert Burgess, 61, Coleman-street, E.C.
Davar, Sohrab Rustomji, 9, Elphinstone-circle, Bombay.
Deepchand, Veerchand, C.I.E., Pedder-road, Cumballa-hill, Bombay.
Doctor, Mervanji Rustomji, Colaba Sanitorium, Bombay.
Hildyard, F. W., Gwydr-lodge, Forest, Snaresbrook.
MacDonald, David Johnston, South St. Roque's Works, Dundee.
Master, Jehangir Rustomji, Chundanwady, Bombay
Mody, Limji Cursetji, Palli-hill, Bandra, Bombay.

Panday, Dady Cowasji, 13, Frere-road, Bombay.

Patel, Nadirsha Darabsha, Queen's-road, Marine-lines, Bombay.

Wright, C. M. P., The Choukpazat Gold Mining Company, Limited, Nankan P.O., Mu Valley Railway, Upper Burma.

The following candidates were balloted for and duly elected members of the Society :—

Douglas, Loudon McQueen, 29, Farringdon-road, E.C.

Eok, Cheah Chen, Green-hall, Penang, Straits Settlements.

Johnston, Thomas, 149, West George-street, Glasgow.

Kendall, Franklin R., 122, Leadenhall-street, E.C.

May, Frederick J., 19, Dorville-crescent, Ravenscourt-park, W.

Muir, John, J.P., Mains-house, Beith, Scotland, and 3, Arundel-street, Strand, W.C.

Windle, Charles Howard, Calcutta, India.

The Chairman, in introducing Dr. Rideal, said if it was a meritorious act to make two blades of grass grow where only one grew before, it must be equally meritorious to devise a method by which food could be preserved, and kept from spoiling until it could be consumed. For many ages the efforts of mankind had been turned in this direction, and many methods had been adopted. In this chemical age it was only natural that assistance should be sought from chemistry to provide preservatives for food, and it was on this subject that Dr. Rideal was about to address them. He was well known in that room and elsewhere, and had given important evidence before the committee of the Board of Agriculture. As the report of that committee had not yet been issued, he would probably feel some delicacy in giving a direct opinion on some of the points raised, but he had no doubt that he would put before them materials on which an opinion might be formed.

The paper read was—

THE USE AND ABUSE OF FOOD PRESERVATIVES.

By Samuel Rideal, D.Sc.Lond., F.I.C.

The subject of Food Preservatives does not seem to have been formally before the Society since the Cantor lectures of Dr. Benjamin Richardson in 1878, and the paper by F. Barff in 1882, dealing mainly with "boroglyceride." Food preservation, however, for a long time formed a rather important department of the Society's work. A special Food Committee sat from the beginning of 1867 until the early part of 1879 to investigate the various methods proposed for the preservation of food. According to information furnished me by the Secretary of the Society, this Committee examin a very large number of specimens and test a great variety of processes, some of whi were favourably commented upon at the tim but the general outcome of its work rath tended to show that none of the methods pr posed, other than those of canning and r frigerating, were successful. With regard the latter, it was only at the end of 1869 th this process appears to have attracted mu attention from the Committee, and the opini then formed was that the proposal w theoretically excellent, but that the m chanical arrangements in use at that tim were not sufficiently perfected to enable t method to be carried out successfully.

Now that a Departmental Committee appointed "to inquire into the use of prese vatives and colouring matters in food, an to report (1) whether the use of such material or any of them . . . in certain quantities, injurious to health, and, if so, in what pr portions does their use become injurious ; (2) t what extent and in what amount they are s used at the present time," a short history their use may afford a fitting introduction to discussion on the subject.

It was early found that perishable soli foods could be rendered more portable and pr served for considerable periods by simple dr ing. In hot countries hanging in the sun wa usually sufficient ; in colder ones artificial hea had to be employed. The first taste f smoked provisions probably arose from th practice of suspending the meat or fish nea the roof where they were penetrated by th vapours from the peat or wood smoke, whicl greatly increased the keeping properties. Th South American "charqui," North America "pemmican," South African "biltong," an the meat dried, pounded, and mixed with fat which was formerly much used in Arcti voyages, are well known. Raisins, figs various herbs, and notably hay, are very earl examples of drying applied to vegetable pro ducts.

Probably the first discovery of the preservative use of *salt* was accidental, and due to th finding of carcases embedded in the incrustations of the many saline deserts of Asia. Plin describes salt as "defuncta etiam à putrescendo vindicans, ut durent ita per secula" (Hist. Nat. xxxiii., 9), and refers to "carnes sale adservatæ," flesh preserved with salt (*ibid*, xxxiii., 10). Columella (de Re Rustica) has "muriâ condire," to preserve with brine. But at periods when fresh food was easily obtained,

reservation was not so much a matter of importance, and therefore there are few early allusions to the use of salt, vinegar, and allied substances except as medicines or condiments.

The difference between various salts was confused, and the names given are difficult to identify. Thus in Jeremiah ii., 22, and in Pliny, *nitre* signifies crude carbonate of soda, since called *natron*, and later in Spain *barilla*, and although the real nitre or saltpetre was collected in India before the Christian era, the beginning of its use for reddening salted meats I have not been able to trace.

The Greeks and Romans made great use of salted fish, but mainly as an incentive to the consumption of wine. It was not likely that salting would be employed popularly, since salt was by no means plentiful, as shown by the word "salary" (salarium), or allowance of salt, coming to mean the payment of officials (Trench). Wine was frequently salted, or made with sea-water, with the object of keeping. Olives, samphire, and other vegetables were preserved in brine. Pickles of various kinds, ταρίχη, were used (Julius Pollux, book vi.).

Alum was known to the Egyptians as a drug, and its astringent and preservative action on flesh is mentioned. The effects of sulphur in fumigation are described by Homer. Boric acid and borax were confused by the ancients with other salts, and valued only as fluxes in the arts. Asiatic borax was first refined at Venice. Boric acid was named by the alchemists "sal sedativus," but without reference to its preservative effect.

Aromatics, on the other hand, from being used for embalming, were eventually extended to food. These generally owed their properties to benzoic or cinnamic acid or to essential oils. Turpentine from *Pistacia terebinthus* (not from pines) was added to wine in Palestine, and is several times mentioned in the Bible. Among the Romans, *myrrh*, the gum-resin of *Balsamodendron myrrha*, which grew throughout the East, had a great reputation for preventing the souring of wine. Pliny (Hist. Nat., xiv., 13), says: — "Lautissima) apud priscos vina erant, murræ odore condita." Essential oils, aloes and other bitters were also used (*ibid*, xiii, 15; Palladius, xi, 14). Bitter herbs were used from the first, and owed their virtues in preventing change partly to their tannin, which coagulated albuminous substances, and partly to essential oils and to alkaloids, which acted as antiseptics. Mugwort (*Artemisia vulgaris*), alecost (*Chrysanthemum balsamita*), and alehoof (*Nepeta glechoma*), derived their Saxon names from their preserving beer; wormwood (*A. absynthium*) was much used for vegetable juices on the continent. Camomile, quassia, gentian, and hop are all bitters of the kind. Acrid substances like pepper were early employed as preservatives, particularly from insects. All these imparted their own strong flavour, and, therefore, their application was limited.

In northern climates the smoking of meats and fish was always practised, and oak or beech wood smoke was preferred, as these yield more of the preserving agents, acetic acid and creosote. The formation of an "empyreuma," or tarry liquor, from wood was early known, and to hasten the process the flesh was dipped in it before smoking, but in this way an inferior product was obtained.

Glauber in 1650 mentions the preservative power of wood-tar, or "the oily part of the distillation of wood, which is more fixed than the acid," and states that if meat is either simply washed, dried, and laid in strong vinegar, or boiled in a weaker vinegar and set aside in a cool place, it will often keep for several months, and that meat will keep fresh for a considerable time if suspended in a close vessel, on the bottom of which some strong acetic acid has been poured. Fish was "soused," or pickled in vinegar and spices in very ancient times.

Although strong spirit was distilled from fermented juices by several ancient nations, it does not seem to have been applied to preserving solid foods, probably on account of its hardening properties. Even at present, "cherry-brandy" is about its only well-known use in this direction, but for vegetable juices, as cordials, spirit was largely employed, usually with spices.

Oil was used at a very early date for preserving fish and for covering wine, and had mainly the object of excluding air. Both uses are still extant, for wine in Italy, and in tinned sardines.

Not only fruits, but meat and fish have been kept by sugar alone. In Portugal, fish are still preserved by splitting, cleaning, and sprinkling the interior with sugar, and laying out horizontally so that the sugar may penetrate as much as possible. It is said that fish prepared in this way can be kept for a long time with a perfectly fresh flavour, especially salmon, and that one or two ounces of powdered white sugar is sufficient for a 5 lb. fish.

Salting.

The only inorganic salt that we intentionally and habitually add to our food is sodium chloride, which seems to be necessary for digestion and a natural instinct, as many wild animals are noticed to regularly visit salt deposits, and will lick lumps of salt. It will be noticed that these natural deposits always contain nitrates, and in many cases borax.

There seems to be no direct equivalent of our word "bacon" in the classics. "Perna" (*Plautus*, Curc., ii, 3, 54; *Persius*, "et piper et pernæ, Marsi monumenta clientis"), "petasio" and "laridum" or "lardum," seem to be the nearest. The word "bacon" is old French.

Salting, as commercially practised, is a process of osmosis or diffusion; a crystalloid applied externally, either as a solid or in strong solution, diffuses into the interior, while the soluble albuminous matters pass out into the brine. Soluble mineral salts, and sugar, also act as partial desiccators by their affinity for water. The flesh is deprived of a great part of its putrescent constituents, but at the same time loses a corresponding nutritive value (Liebig estimated the loss at one-third to one-half), and leaves nearly insoluble fibrinoids, partially hardened and less digestible, "induratas sale," as Pliny says (Hist. Nat., xxviii, 20).

After either smoking, salting, or drying, the characters of fresh food cannot be restored. It was not till the middle of the 19th century that it was discovered that small quantities of certain antiseptics would enable the original qualities to be retained, and prevent decay for a considerable period, with less influence on digestion than the old curing processes.

The quantity of mineral matter introduced in salting is considerable. A mixture of 2 lbs. salt, 2 oz. saltpetre, and 1½ oz. moist sugar is rubbed thoroughly into the meat, which is then kept in a cool place and turned daily, rubbing in fresh salt where required. When the brine, as it forms, is drained away from the meat, the process is called *dry-salting;* if it be allowed to remain on it, it is called wet-salting or pickling. A pickling brine is made with 4 lbs. salt, ½ lb. to 1 lb. sugar, and 2 oz. saltpetre in 2 gallons of water. The liquor, in time, becomes diluted by the meat juices, and is also apt to turn foul, therefore, at intervals, it is boiled down with more of the dry ingredients and skimmed, which has the effect of sterilizing it, and removing albuminous matters. For a fine red colour the saltpetre is increased to about 8 per cent. of the pickling salt. In America it is usual to add to the brine about ½ per cent. of bicarbonate of potash or "saleratus" and creosote sometimes in the proportion of one drop to the gallon.

In this way a high amount of salt, and an appreciable quantity of nitre is consumed with the food. Thus in mild-cured bacon I have found the following percentages:—

	Sodium chloride.	Potassium nitrate.
Raw	4·27	·0083
Smoked	3·34	·0086
Smoked and boiled	2·38	·0065
Smoked and grilled	2·24	·0086

The antiseptic power of salt is decidedly weak, hence the need for large quantities. Pringle, who was one of the first to introduc direct experimental methods in the study o disinfectants, in his "Mémoire sur les Sub stances Septiques et Antiseptiques" (Acad. des Sciences, 1750), which is of classica interest, found sodium chloride so weak a antiseptic that he placed it the lowest in hi scale of bodies investigated. In further ex periments he proves that salt more commonl *hastens* putrefaction; for in the proportion c 10 to 20 grains to 2 grains of beef and 2 ounce of water, the salt softens and dissolves th meat, and "by a septic virtue favours it digestion." He cites other authors who hav admitted the "putrefiant" nature of sodiur chloride. In many cases brine becomes con taminated with ptomaines. The meat, how ever, is usually washed before cooking.

Occasionally carbolic acid or phenol ha been added to brine; but it is an objectionabl antiseptic for food on account of its odou taste, and poisonous character. *Carbol paper* has, however, been much used i Europe for packing meats: it is made b mixing 5 parts of paraffin wax, 5 of steari and 2 of phenol, and brushing in a melte state over paper.

Preserving Food by Gases.

About fifty years ago, Pelouze, from th observation that carbon monoxide was absorbe by hæmoglobin, forming a compound that wa hardly putrescible, devised his process for th use of this gas as a preservative.

The meat was cut up into pieces of co venient size, and placed in an atmosphere carbon monoxide, under pressure. It was the dried in a current of air, and sealed up a tight, or might be kept in a solution of salt

ltpetre, or in "much diluted carbolic acid." Carbon dioxide, CO_2, seems to have a special ıtiseptic action, as Slater* found that this ıs in mineral waters has a remarkable effect killing pathogenic bacteria (typhoid, cholera, aph. pyogenes aureus, Finkler-Prior bacillus), ıd Hochstetter found the same in the case typhoid, cholera, rabbit septicæmia, Microccus tetragenus, Finkler-Prior bacillus, spergillus flavescens (a yellow mould), and ıthrax bacilli, but not anthrax spores.

It is well known that fermented liquors preerved in bottles remain stable for long periods, ıd this stability seems difficult to explain by ıe self-exhaustion or deposition of all the acteria present. Bethell, in 1848, patented a rocess for preserving milk, which consisted in rst boiling the milk to expel all the air conıined in it, and then saturating with carbon ioxide; when so treated, the liquid remains esh for a long time after being opened. More ecently compressed oxygen and sterilised air ave been tried for preserving milk. Butter, hen kept in carbonic acid, at a pressure of x atmospheres, often remains unchanged for our or five weeks.

In May, 1898, I examined a leg of mutton ıat had been preserved raw in CO_2 since December 2nd, 1897. Although it had lost ome of its colour and had softened it had no ffensive odour. When either stewed or roasted was quite palatable and produced no illffects. The fat was normal and the cold water xtract differed slightly from that of fresh ıeat, but the broth was much less savoury. The minced flesh when kept for four days imply dried up and became covered with ıould, but did not acquire a putrid odour as esh meat did. Comparative analyses gave fat excluded):—

	Preserved leg.	Fresh mutton.
Vater	71·53	75·19
oluble albumin and globulins	0·86	2·49
oluble inorganic salts	1·12	0·95
nsoluble ditto	0·32	0·28
Organic extractives:—Albumoses, peptones, and flesh bases	5·44	3·40
elatinous matters extracted by water under pressure for six hours at 115° C.	2·69	2·26
	100·00	100·00
Total cold water extract	7·42	6·84
Total ash	1·44	1·23

A larger number of bacteria were present han in fresh meat, chiefly consisting of a motile bacillus, not putrefactive, very resistant, and facultatively aerobic.

* Journ. of Pathol. and Bact., 1893, i. 468.

From this and other experiments it appears that carbonic acid, though generally effective for mineral waters, will not of itself prevent changes in milk or meat.

The vapour of carbon disulphide was proposed in 1878 for preserving meat.

Hydrogen Peroxide.—Paul Bert and Reynard (Berl. Ber., xv., 1585), speak very highly of this substance as practically one of the few disinfectants which have no effect on digestion and yet prevent the interfering action of organisms. They state that all fermentations caused by bacteria are at once stopped by the peroxide, while no effect is produced on the digestive enzymes, dissolved fibrin, albumin, casein, fats, sugar, or starch. The bactericidal influence of light is attributed to the formation of hydrogen peroxide, and experiments have shown that a strength of about 1 in 1,000 is required for efficiency. M. Touchard has recently reinvestigated its action on several bacteria and fungi, and considers it one of the most useful of germicidal agents (Bull. Gén. de Thérap, March, 1899).

Injection with various fluids has been often tried. Morgan in 1857, before this Society, explained his process for injecting a salt and nitre solution through the vessels of recently killed animals to wash out the blood, but the method was not always successful in preventing putrefaction. M. Gannel even injected aluminium chloride: this deleterious salt was intended to be removed before use by soaking for 24 hours in water. It is well known that meat shows a tendency to first become tainted "near the bone" or at the joints. Consequently a practice has arisen of injecting a preservative solution, usually boric acid, into the acetabulum and other joint cavities to wash out serous accumulations and leave a small quantity of the antiseptic. The method seems successful, and has the advantage of introducing a minimum of the chemical substance.

Acids.

Since the great majority of bacteria grow best in neutral or alkaline solutions, nearly all acids have more or less inhibitive power on putrefaction. Meat has been preserved by immersing repeatedly in dilute hydrochloric acid and drying. When required for use it was dipped in dilute sodium carbonate; only salt was then left. Vinegar and acetic acid have already been referred to.

A "butter preservative," imported into the United States, was diluted phosphoric acid (1887).

Sulphur dioxide, or sulphurous acid, is one of the oldest of the antiseptics, and as produced by burning sulphur was known to all the ancient nations. Wine casks and skins were sulphured.

At Augsburg, in 1400, a special law was enacted, forbidding the sulphuring of casks. In the records of the Common Council of London, in 1635, certain wines were pronounced unwholesome, and condemned to be destroyed, because, among other things, they contained "some quantities of sulphur."

Sulphurous acid and the bisulphites absorb oxygen, therefore prevent aerobic organisms from acting, and so retard souring and many changes. They are much used by brewers for casks, and in finings, by makers of lime juice, liquors, and cordials, bottled beers, bottled fruits, sometimes by vinegar makers, and powdered bisulphites by butchers.

The poisonous bisulphite of zinc has been patented for preserving meat.

The quantity of sulphurous acid or bisulphites required to kill or inhibit organisms has been very variously stated. The efficiency is considerable against moulds and ferments, but when used in effective amounts they are apt to communicate a bad taste. In canned goods they are objectionable, as they dissolve the metals. Sulphites do not seem to have been noticed yet by the Departmental Committee, although they are probably more commonly used at the present time than any other preservative.

Salicylic Acid furnishes an example of the different antiseptic value of closely allied substances. There are three isomeric oxybenzoic acids, C_6H_4 (OH), COOH, of which the ortho- (salicylic) is twice as powerful an antiseptic as the para-, while the meta-acid has intermediate properties. "Artificial" salicylic acid when imperfectly purified from the *cresotic* acids, seems to have stronger physiological effects than the "natural" acid from oil of wintergreen, and the objection to its use as a preservative may partly be attributed to this cause.

The sensitiveness of different bacteria to salicylic acid seems to vary, and Vallin, Neubauer, and Bechamp have shown that many bacteria and ferments rapidly acquire a tolerance towards it. This probably accounts for the discrepancies in the statements as to strengths required for killing organisms, such as Jalan de la Croix, 1 in 200 for milk, an more than 1 in 35 for germs in meat juice Kuhn, 1 in 200 for germs in albumen solution Bucholtz, 1 in 362; Ratimoff, 1 in 400. O sodium salicylate, the quantity is stated as in 100 by Miquel, and 1 in 161 by Bucholtz In other cases, salicylic acid was found to b "without effect on bacteria, even in quite larg quantities" (Journal Chem. Soc., xxxiv., 258 Pharm. Journal, 1881, p. 765), while Dragendorff states that "sodium salicylate has stronger action on *certain bacteria* tha phenol, quinine, boric acid, or alcohol, an has about one-third the power of salicyli acid."

Many additions are made to increase th solubility of salicylic acid, which is only in 500 of cold water; of these, borax an glycerine are the most frequent. Several bee preservatives have consisted of sodium salicylate and borax dissolved in glycerine; willo bark, salicin, and poisonous bitters have als been found (Battershall).

In many countries the use of salicyli acid is prohibited. In England it has bee largely used in syrups, temperance drinks and "British wines."

Benzoic acid dissolves in 220 parts of col water. Researches in 1873 and followin years attributed to it a greater antisepti power than phenol or salicylic acid.* Salkowski† showed that benzoic acid, in a dos smaller than salicylic, prevented for a lon time the putrefaction of meat juice and th development of bacteria. Bucholtz found tha 1 in 1,000 stopped the growth of microorganisms.‡ Jalan de la Croix|| proved tha the least quantity which would prevent bacterial growth from being inoculated into fresh liquid (beef-tea) was 1 in 2,800. T kill bacteria he required 1 in 400, to sterili spores 1 in 50. Vallin's work (Désinfectants, p. 202) practically agrees with th estimate. As regards non-organised ferment ("enzymes") Wernitz§ states that pepsi is "neutralized" by 1 in 200, and others by in 300, of benzoic acid or benzoate of soda Graham Brown¶ placed sodium benzoat higher as a bactericide than quinine hydrochloride or sodium salicylate. The physiologica

* *Med. Times and Gaz.*, ii, 488; Pharm. Journ., 187 p. 307.

† Antisept. Wirkung d. Salicyl. u. Benzoesäure, Be Klin. Wochenschr., 1875, p. 22.

‡ Archiv. f. Exp. Pathol., 1875, vol. iv.

|| *Ibid*, 1881, xiii, 175.

§ Dorpat Essay, 1880.

¶ Kleb's Archiv., viii., 140.

ffects are said to be much less than those of alicylates. In fact benzoic acid exists in he urine of man and hippuric (glycocine-enzoic) in that of the herbivora.

Benzoic acid prevents fats from becoming ancid, as in Adeps benzoatus (benzoated lard), 3.P. The benzoates have less taste and odour han the free acid, and in the small quantity hat is required they would seem to be an un-bjectionable preservative. Their use for pre-erving milk and provisions was suggested in ngland in 1886.* Where the taste and odour o not interfere a saturated solution of benzoic cid in water delays the putrefaction of animal natters much more effectively than salicylic. t has less effect on vegetable infusions. Added o milk a very small quantity prevents coagu-ation.†

The introduction of the sulphonic group isually increases the solubility of organic ompounds, diminishes the odour and action n animals, while rather augmenting the anti-eptic power; hence many bodies of this class re used as preservatives, such as *phenol-ulphonic acid*, benzosulphonic (as "sodium ulphobenzoate"), "saccharin" (benzoyl-ulphonic imide), and others.

Fluorides.—The antiseptic properties of hese salts are considerable. Many years ago, V. Thompson advocated the use of *sodium ilicofluoride*, under the name of "Salufer.")r. Effront in 1892 found that hydrofluoric cid and the alkaline fluorides protected wort rom lactic and butyric fermentation, and ctually increased the diastatic power of malt. Recently attention has again been directed to heir use, and in comparative experiments I iave satisfied myself that they are equal to he corresponding benzoates in molecular pre-ervative property.

Glycerine has been much used, but mainly s an adjunct to, or solvent of, other preser-atives, and for disguising taste. A. Schmidt‡ tates that glycerine, alum, and sodium icarbonate are added to beer, and that "beer poor in extractive and alcoholic con-tituents is liable to become sour, a defect vhich is remedied by the use of alkalies and halk, the resulting disagreeable taste being isguised by means of glycerine."

On account of its sweet taste, non-suscep ibility to alcoholic fermentation, and slight ntiseptic property, glycerine has been largely ised in wines, temperance drinks, and beef-juice extracts. It is, however, only a preservative in strong solutions (22·5 per cent. Michél); weaker ones undergo a butyric fermentation.

Hams and dried fish have been soaked in 20 per cent. glycerine for preserving, but its hygroscopic property has militated against its use in this direction.

Molecular Proportions.—It is evident that in contrasting a series of salts of the same acid, a solution containing in the same volume an equal number of molecules of the salt must include in each case an equal weight of the acid groups; any difference in the behaviour will then be due to the variation in the base.

Similarly by taking molecular proportions of the different salts of one metal, the influence of the molecular weight of the different acid groupings upon the retardation in the development of the putrefactive organisms may be traced.

In some experiments in this direction, not yet published, I have determined the retardation in the souring of milk by molecular proportions of different salts, and find that the alkaline metals, potassium, sodium, and lithium, show great resemblance, whilst the equivalent of ammonium, probably owing to its decomposition, distinctly promotes the production of acid.

With regard to the acid radicle, chlorides are conducive to souring—common salt especially not only not hindering, but actually often accelerating the decomposition. Nitrates, on the other hand, have an inhibitive effect. Benzoates and fluorides have a decidedly preservative action, which for short times is greater in the former, and is specially marked in benzoic acid. Probably owing to their decomposition, the effect of benzoates wears off in longer times, whereas that of fluorides remains fairly permanent.

Boric Acid and Borates.—The knowledge of the preservative action of these compounds is, as we have seen, quite of modern date. The discoverer, Gahn, introduced a mixture of boric acid and alum as "aseptine" for preserving food. It was stated that boric acid alone caused the formation in a few months of a blackish crust, but that alum prevented this; the same end is now attained by the addition of borax. Aseptine had no action on moulds. In August, 1872, M. Dumas introduced boric acid and borax to the French Institute as preservatives for food. The sparing solubility of boric acid (about 4 per cent.), and its tendency to crystallize out, were obviated by

* "Chemical News," 1886, i., 130.

† Horn, "Zeits. f. Chem. Ind.," 1888, ii., 320.

‡ (Archiv. der Pharm., 1885, vii, 392).

combining it with many substances, such as tartaric and other acids. In 1882, F. Barff read a paper before this Society on his "Boro-glyceride," a very soluble ester of glycerine and boric acid, made by heating the ingredients together. Le Bon* recommended calcium and sodium boroglycerates. A great variety of boric mixtures have since been introduced under different names, and are very largely used at the present time, especially for the preservation of milk, cream, and butter.

Boric acid appears to be widely distributed in small quantities in nature. The following are recorded instances:—

Hotter (Year Book of Pharmacy, 1891, 107): in most fruits.

Gassend (Ann. Agron., xvii. 352): grapes, apples, tomatoes, radishes, lettuce, and occasionally in pears.

Passerini (Staz. Sper. Agrar., xx. 471, and xxi. 565): in the stems of tomatoes.

J. Brand (Zeits. f. d. ges. Braw., 1892, xv. 427): occurs normally in beer, and emanates from the hops, in every variety. 100 cc of beer, or 5 grammes of hops, suffice for its detection.

Kayser (Chem. Zeit., 1890): carrots, beet sugar, Californian wines, &c., *and often introduced into the glaze of enamelled vessels.*

Georges (J. de Pharm., 6, iii. 346) points out that boric acid is present in purified caustic potash and soda.

Formaldehyde. — Its antiseptic properties were discovered by Loew and Fischer in 1886, and were further examined and turned to practical account by Trillat in 1888. A large number of observers have since investigated it, and have agreed that it is one of the most powerful of all antiseptics. In 1894, with Dr. Slater, I found that 1 in 20,000 inhibited the growth of several typical bacteria, while 1 in 2,500 was required to prevent the growth of yeast, suggesting the use of formaldehyde for arresting secondary fermentations in alcoholic liquids.† It has also been applied successfully, either in solution or vapour, to milk, meat, and other articles of food.

Formaldehyde may even exist naturally in food, as Pollacci has separated it by distillation from leaves which have been exposed to light and macerated in water.‡ In commerce it is met with as a 40 per cent. solution called "Formalin."

Last May, Mr. A. G. R. Foulerton and myself, in a paper published in *Public Health*, expressed our opinions (1) as to the quantities of boric acid and formaldehyde necessary for preserving milk, and (2) the possibility of such quantities having injurious effects. Since then, Mr. Foulerton has further dealt with the second branch of the subject, and his conclusions, in which I concur, are given in *The Lancet* of Nov. 25th (p. 1427) and Dec. 9th (p. 1577), 1899.

A good deal of recent criticism has assumed the possibility of comparatively large doses being present in food supply. But milk is practically the only article of food which is consumed in sufficiently large quantities so as to cause the amount of preservative to possibly assume toxic proportions. In the paper referred to we stated that 1 part in 2,000 of boric acid mixture (4 grains to the pint) and 1 in 50,000 of formaldehyde were quantities of preservatives sufficient for keeping milk sweet for a period of 24 hours even in warm weather.

These quantities cause some slight retardation when the examination is made before the digestion is completed, that is, after equal times, but a little longer time sufficed to ensure the complete digestion of the preserved food. It is also important to recollect that both preservatives have practically no effect upon the digestion of casein, and therefore, in a milk diet, their effect is less marked than when the preservatives are used with meat or starchy foods. The following experiments show that the influence of these preservatives in the above quantities is comparable to that of condiments, or alcohol or tea, upon starch digestion:—

Breadcrumb, 5 grm., with 50 c.c. water, exposed to Action of Ferment for Half an Hour.

	ZYMINE.			SALIVA.		
	Maltose produced.					
1. Nothing added	0·5395	=	100	0·707	=	1[illegible]
2. Formic aldehyde, 1 in 50,000	0·477	=	88·5	0·672	=	9[illegible]
3. Boric acid, 1 in 2,000	0·423	=	78·5	0·607	=	8[illegible]
4. Malt vinegar, 2½ c.c.	0·258	=	48	0·1647	=	2[illegible]
5. Salt, 0·2 gramme	0·52	=	97	0·70	=	9[illegible]
6. Worcester sauce, 1 c.c.	0·5	=	93	0·57	=	8[illegible]
7. Alcohol, 5 per cent. (claret and water, 25 c.c. of each	0·47	=	88	0·701	=	9[illegible]
8. Tea, ⅓ gramme infused in 50 c.c. of water	0·491		91	0·650		9[illegible]

In the pancreatic digestion of casein, no difference could be observed in the amount of casein digested with and without formaldehyde, whereas an addition of a small quantity of infused tea, claret, or Worcester sauce to the milk reduced the amount of digested casein to a small but noticeable extent. The conclusion is that the small amount of preserva-

* Comptes rendus, xcv., 145.

† *Lancet*, April 21st, 1894.

‡ Chem. Centralblatt, 1899, ii., 881.

ive has actually less effect than these ordinary additions to food.

Other investigators have also found that many ordinary food substances have an effect on digestion quite comparable with that of these small quantities of preservatives. Thus E. Laborde* digested coagulated egg-albumen with pepsin or trypsin at 40° C. for three to four hours, alone, and in presence of various bodies allied to the alcohols. He finds that while some of the substances present in beverages, such as isobutyl alcohol and glycerine, are distinctly favourable to both peptic and pancreatic digestion, ethyl alcohol, lactic and tartaric acids retard them. According to this author, dextrose assists pancreatic, but delays peptic, digestion.

At the present time these quantities are frequently exceeded, and I think most of us hope that the Departmental Committee will make it compulsory for the presence of *any* preservative in milk to be declared at the time of purchase, as it is now agreed that in special cases, such as of invalids, the consumer should be able to obtain a milk free from preservative, and in all cases he should be aware of its presence. In such declared milk any amount of boric acid or formaldehyde in excess of the limits mentioned above would be foreign additions to such declared milk, which no vendor could put forward as necessary preservatives.

Recorded cases of the toxic effect of boric acid showed that fifteen grains a day may, in a fortnight, produce skin eruption in susceptible individuals (adults), so that this quantity must be regarded as the maximum amount per day which may be safely taken by an adult. An invalid on milk-diet could possibly take as much as twelve grains per day—that is, in three pints—so that the toxic limits would be very nearly reached in such a case; whilst a child aged six months might take as much as thirty-two ounces of cow's milk per day, or about six grains per day; and this quantity, in relation to the body-weight, approximates to the amount which, in some individuals, has produced injurious effects. Of bacon, 3 lbs. to 6 lbs. must be consumed daily to give a toxic dose. In cream and butter, the toxic quantity with 1 per cent. preservative amounts to about ½ lb. per day.

The advisability of allowing greater amounts of preservatives than those mentioned to be present in "declared" milk is determined by the question whether the larger quantities are necessary for trade purposes. This point, of course, depends largely what is understood as "sour milk" by the consumer, and this must obviously depend upon the acidity of the milk expressed in terms of lactic acid. In the following Table I summarise the results obtained in a series of experiments undertaken to ascertain this point. Quantities of fresh milk containing (1) in 2000 of boric acid, (2) 1 in 50,000 of formaldehyde, and (3) a control, were kept at the following temperatures: 13° C., 18° C., and 24° C. (as representing approximately winter, medium, and summer temperatures); and the amount of acidity in terms of lactic acid determined after different intervals of time. The milk used had an acidity corresponding to 0.18 per cent. of lactic acid:—

TABLE I.

	Per cent. lactic acid.		
	13° C. (55·4° F.)	18° C. (64° F.)	24° C. (75·2° F.)
Fifteen hours:—			
Blank	0·182	0·202	0·232
Boric acid	0·180	0·180	0·216
Formaldehyde	0·182	0·180	0·194
Twenty hours:—			
Blank	0·184	0·205	0·245
Boric acid	0·180	0·198	0·220
Formaldehyde	0·178	0·179	0·198
Twenty-three hours:—			
Blank	0·184	0·210	0·281
Boric acid	0·180	0·180	0·241
Formaldehyde	0·178	0·181	0·223
Thirty-nine hours:—			
Blank	0·191	0·392	0·799
Boric acid	0·178	0·259	0·648
Formaldehyde	0·173	0·209	0·590

From these results it will be noticed that at the lowest temperature—viz., 13° C.—even after 39 hours there is no increase in the acidity of the milk containing boric acid and formaldehyde, the actual titration recording a slightly lower amount of lactic acid. (The possible experimental error in these figures amount to + 0·007 per cent. of lactic acid.) In these two milks at 18° C. there is no appreciable rise in the acidity till after 23 hours' incubation, whilst the unpreserved milk shows a gain of about 15 per cent. In considering the results at 24° C. the question arises as to what maximum acidity can be allowed to milk

* Journ. de Pharm., 1899, vi, 10, 484.

without its being pronounced sour. In some milk the rate of production of acidity is much greater than this, as it obviously depends on the number and kind of organisms present.

Thorner* has investigated the acidity requisite to coagulate milk on warming as corresponding to 0·207 per cent. of lactic acid, but I have found (*Lancet*, January 27, 1900) the coagulating point somewhat higher than this, as the coagulation is not very marked even when the acidity is 0·23 per cent., and I believe that when the acidity exceeds 0·25 per cent. of lactic acid the milk would be considered sour and unfit for sale. Taking this as the maximum acidity allowable, it will be seen that in all cases the milk has been kept sweet by the 1 in 2,000 of boric acid, and 1 in 50,000 of formaldehyde, for over 23 hours. Even if Thorner's limit of 0·207 per cent. of lactic acid be taken it will be seen that the quantity of boric acid and formaldehyde suggested are ample for keeping a milk sweet for 23 hours at 18° C. But the quantity of boric acid is insufficient for keeping it sweet for a longer period than 15 hours, and of formaldehyde for a longer period than twenty hours, when the temperature is as high as 24° C. The initial acidity of milk varies very considerably, and may be as high as 0·1 per cent., so that, taking it generally, the work required of the preservative is to arrest the production of one-tenth per cent. of acidity calculated as lactic acid in the milk during the time which must necessarily elapse between the time of milking and the time of consumption.

Another important point to bear in mind is that a preservative is obviously more efficient if added to the milk at the time of milking so that the development of the organisms present in the milk is retarded from the very commencement. The legitimate use of milk preservatives should be restricted to the farmer or cowkeeper and removed from the middleman, or vendor, or consumer. It is urged by some that the consumer could preserve his milk if he thought it was necessary, but without entering into a discussion of Dr. M. K. Robinson's case, and dismissing for the moment Dr. O. Liebreich's reply to it, which in my opinion seems clearly to establish that the poisoning was not due to boric acid, such a method of dealing with the problem would open the way to future cases similar to that of Dr. Robinson in which excessive doses of preservatives might be taken by susceptible individuals.

In the case of butter the loss of flavour and the beginning of rancidity are very carefully gauged by experts, so that points or marks of value are assigned to butters which give their commercial value. In the report for the New Zealand Department of Agriculture for 1898 Mr. Sorensen shows that butter containing 3 per cent. of salt and ½ per cent. of boric acid and subjected to cold storage yields on keeping a butter having the greatest number of points, 37 out of 45, whilst butters with 1 per cent. of boric acid and only 2 or 3 per cent. of salt gave an inferior result, and those containing either more or less salt without boric acid had lost still more flavour. These results show that in this particular case it is to the interest of the trader to keep the boric acid low, as from the commercial point of view the butter with ½ per cent. of boric acid has a better flavour and will fetch a better price than that containing 1 per cent.

I wish also to refer to the value of feeding experiments. Those published by Mr. Foulerton and myself with milk containing formaldehyde proved that adult animals, although their body weight was far less than that of man, could consume large quantities of milk with moderate amounts of preservatives without apparent injurious effect. It has been pointed out by Dr. H. E. Annett and others that the cats used in these experiments were three months old, but we did not mention that we had previously attempted to feed kittens three weeks old similar to those used by Dr. Annett, without success, as we found that kittens at this age, when taken directly from their mother, were not capable of assimilating undiluted and unpreserved cow's milk, and six kittens thus fed died under our hands. I attribute this partly to the fact that cow's milk is an unfit food for young kittens, as it is well known that the characteristic of cat's milk is that it contains 6 per cent. of albumin, a constituent which is only present in cow's milk to the extent of about ½ per cent., so that such food is as unsuitable for young kittens as undiluted cow's milk is for infants. It will be noticed in Dr. Annett's experiments* that in these young kittens the results were very irregular, and that whereas the normal rate of increase per week should be from 30 to 40 grammes, or roughly 10 per cent. of the body weight, in kittens receiving untreated

* Chemische Zeitschrift, 1891, p. 1,108.

* *Lancet*,

nilk, in some cases he actually obtained *lecrease* in weight, and in others only an ncrease of two or three grammes. The ıeavier and older the kittens the more reliable ıre the results. It is singular that Dr. \nnett, with the smaller quantity of preserva-ive (40 grns.), obtained two deaths out of five n the third week, whereas with the larger juantity (80 grns.), all the animals survived. Similar irregular results were obtained by him vith the milk containing formaldehyde, as he btained three deaths with the weaker solution, ıone with the formaldehyde of 1 in 25,000, and wo with the stronger solution. Before these xperiments of Dr. Annett were published I ıad carried out a few feeding experiments with .ittens about five weeks old, at which age they an take cow's milk freely, but I restricted the uantity to about 70 cubic centimetres per nimal per day and used the preservative in he proportions already advocated, so that ach kitten received about half a grain of boric cid per day. The results are summarised as ollows :—

TABLE II.

	Average weight in grammes of animal fed on—			
	Milk.	Milk + formal-dehyde.	Milk + boric acid. (1)	(2)
st week ..	517	591	595	630
nd week ..	537	657	646	664
rd week ..	610	674	684	744*
Percentage increase in weight on first week.				
nd week ..	3·87	11·1	8·6	5·4
rd week ..	18·00	14·1	15·0	18·1

* In the third week this kitten was fed on formalised milk stead of borated milk.

Making allowance for the difference between ifferent animals and the irregularities always oticed in animal experiments, the natural ıcrease cannot be said to be interfered with. .s pointed out by Dr. Liebreich we have in Dr. .nnett's experiments no information given us as the quantity of milk supplied to the kittens, nd it is quite possible that they received a ıuch larger quantity of preservative than the bove. As a kitten weighs approximately ne pound and I gave mine half a grain of oric acid per day, it would follow that a hild six months old, weighing 12 lb., could ıke six grains of boric acid a day, or, ay, a pint and a half of preserved milk. If ny value, therefore, is to be attached to nimal experiments, the relation of body weight to the amount of preservative exhibited must be taken into account. Of course, this relation is recognised in the Pharmacopœia, but it is well known that the usual allowance for doses for children of some drugs does not obey any definite law. In the Pharmacopœia this quantity of six grains of boric acid per day for a child six months old would be about eight times the medicinal dose. I am, therefore, inclined to agree with Mr. Foulerton that experiments on animals have, after all, but a very slight bearing upon the problem under investigation. As Dr. Liebreich points out, even regarding Dr. Annett's experiments in their most favourable light, they by no means prove that boric acid and formaldehyde are poisonous for young children, even in quantities largely in excess of those which would be possible in a milk diet when the preservatives were regulated in the way suggested.

DISCUSSION.

The CHAIRMAN said this paper was very interesting both in its historical portion and in that which dealt with the modern practice of using preservatives, which must be looked at from two opposite points of view. The intention that of preserving food was an excellent one, but on the other hand it might be legitimately contended that the introduction of any chemical into food was a matter of great gravity to the consumer, especially in the case of children, and should not be allowed without due restrictions.

Dr. J. ATTFIELD said Dr. Rideal had given a most admirable *resumé* of what was known as to the use of preservatives, and had contributed fresh knowledge from his own researches; he alluded partly to his endeavour to get at the relation of the molecular weight of the substances used to their antiseptic power, and to his observations on the amount of preservative necessary to effect the desired object. He had not gathered much with regard to the abuse of these agents, but had learned a good deal respecting what he should prefer to call their unwise use. This impression, derived from considerable experience, was that manufacturers, who were looked to for advice as to the amount to be used, had been rather at sea in answering such questions, because of the absence of such specific information as Dr. Rideal had now given. With regard to the unwise use of preservatives, he could support almost everything that had been said. He had found, by long and unhappy experience, that the quantities commonly recommended were excessive. The present race of medical men, no doubt getting their information from their predecessors, had been in the habit of giving too large doses; and some five years ago, when the question of the action of boric acid came before the

Medical Council, when a committee was dealing with a new edition of the Pharmacopœia, he ventured, as editor of that book, to lay before them his own experience, which accorded so well with their own views that they reduced the old dose by one half. He had also found that even still smaller doses of boric acid, salicylic acid, creosote, and carbonic acid were, as tested on his own digestive organs, quite sufficient. Some twenty years ago, finding himself terribly dyspeptic, he sought the best medical advice, and after trying the usual stimulants and tonics, was recommended to try antiseptics. These he tried for some years, and found that they did prevent the unnatural decomposition of food in the stomach, which arose from its remaining there too long, and which gave rise to gas distention, and sometimes great pain; but they did not strengthen the gastric organ, the food still remained too long, and mechanically irritated the stomach, and he was obliged to have recourse to the stomach tube, washing out the stomach a certain time after each meal, and removing the food which still remained undigested. Both chemically and microscopically he examined scores of times the result of this process, and found that boric acid did not in the slightest degree retard the natural digestion of food in the stomach, at which he was rather surprised, because it was well known that salted and smoked meat was not so easily digested as fresh. What really took place was that the salt hardened the meat, and so indirectly retarded digestion, but directly it had no such effect. He thought too large quantities of preservatives were often used, and quite agreed that when used, the nature and quantity of the agent employed should be notified.

Mr. C. E. CASSAL said Dr. Rideal's experiments were extremely interesting, but he did not see how they bore on the point whether or not it was desirable or excusable to make use of chemical preservatives in food. If the intention was to apologise for the use of these chemicals, he thought both Dr. Rideal and Dr. Attfield had given themselves away. They both said that every article of food so treated should be labelled. Dr. Rideal spoke of the toxic effect of these substances, and Dr. Attfield also seemed to imply that there was a toxicity about them which it was well to bear in mind. But was it desirable that any substance known to possess toxic properties should be introduced into food at all, even if it were notified? Personally, he had never felt any doubt about the matter, he thought it should be prohibited under severe penalties, and he believed he was the first public analyst to report the presence of such things to his authorities, and to suggest that legal action should be taken to stop the practice. Although things moved slowly he was glad to find that at length a committee was appointed by the Board of Trade to consider the matter, and he believed the result would be to protect the public against the indiscriminate and unwise—as Dr. Attfield called it, but he should say highly objectionable, use of preservatives in articl[es] of food. If the chemical was present in sufficie[nt] quantity to exert its specific effect, by that very fa[ct] the article of food was rendered improper for use. D[r.] Attfield had offered himself there, as he had before t[he] committee, and in courts of law, as an awful examp[le] of dyspepsia, but that very fact put him out of co[urt] as a witness to what would suit ordinary, healt[hy] people. Nor were statements as to the effects [of] Worcester sauce, vinegar, and so on, of any relevanc[e.] Infants did not want Worcester sauce mixed wi[th] their milk; neither did they want boric acid [or] formaldehyde. It was well known that refrigeratio[n,] which added nothing and abstracted nothing, w[as] the proper method of preserving food, and he did n[ot] see why the use of chemicals should be allow[ed] instead, simply because they were cheaper. It w[as] practically admitted that experiments on anima[ls] were of no use, and it was practically impossible [to] prove injury, so that the only safe course was absolu[te] prohibition. If you produced half a dozen awf[ul] examples in court, who had been rendered miserab[le] by taking these things, the other side would produ[ce] half a dozen Sandows, who would testify that th[ey] had eaten borax and salicylic acid by the pound, an[d] were stronger and better than most people. Stripp[ed] of all verbiage, his proposition was that the additio[n] of these things to food was dangerous adulteratio[n,] and he hoped it would be condemned as such by t[he] Departmental Committee.

Dr. DUDFIELD, speaking as a Medical Officer [of] Health, not as a chemist, said he should be incline[d] to forbid the addition of any chemical preservatives [to] food. Dr. Rideal's experiments had been limited [to] a certain standard, where the quantity was very sma[ll] and possibly innocuous, but the difficulty was that [in] practice the amounts found were very much in exce[ss] of the quantities he had mentioned. He could n[ot] remember the exact figures, but if Dr. Attfield kne[w] the amount of boric acid which had been found b[y] Dr. Alfred Hill, of Birmingham, in milk, butter, an[d] cream, he would admit that there had been a co[n]siderable abuse. It was not a question of how muc[h] you could take in one particular food without har[m,] but of what was the effect of the quantities in a[ll] the various foods in which these things were use[d.] You began in the morning with milk and butter; [at] dinner you had it again probably with your fish, an[d] with your butter, and possibly in your cheese; yo[u] were taking it at every meal in some form or othe[r.] Unfortunate infants who had to be brought up b[y] hand, might take as much as 20 grains of borax in [a] day. The opinion he had formed was that boric ac[id] was distinctly harmful to certain classes of peopl[e.] Great efforts had been made of late years to decrea[se] the mortality from zymotic diseases, and in ma[ny] cases with considerable success, but infantile diarrho[ea] was unfortunately on the increase, and he thoug[ht] possibly the increased use of preservatives mig[ht] have some connection with it. He did not s[ee]

ıe necessity for having preservatives at all. had been put to him that some of the ıilk which arrived at Paddington came from ornwall, and that, unless some preservative were ıdded, it would not stand such a long journey. He elieved it would if the farmers took proper precauons in the milking and cooling of the milk before ending it off, and if proper appliances were provided. [e knew of one station in Cornwall from which only small quantity of milk came, and that was carried an ordinary goods van, without any attempt at entilation. He should like to see all milk dealt with, the first instance, at creameries, where it should be roperly filtered and refrigerated, and then stored in ıns absolutely free from contamination. He had ecently had a sample of milk sent him, which was ut in a bottle on March 2nd; it stood in his oom until the 18th, when it was opened, and ıd been standing open since, and on that ay it was perfectly sweet. It was not boiled, ıt had been treated with oxygen, and he intended aking further investigation into the process. The e of chemical preservatives favoured careless habits ıd the neglect of cleanliness and other precautions, ıd you never knew how many times the chemical ight have been added by different persons through hose hands the milk had passed. If it were allowed all the quantity shonld be strictly defined and ıted, and any excess should be treated as an lulteration.

Miss WEBSTER said a good deal of the milk sold London would not curdle either by the addition rennett, lemon juice, or vinegar.

Mr. A. ZIMMERMANN asked if those who were so aid of preservatives never ate kippered herrings or ıoked salmon, and if they were aware that the eping capacity of those articles was due to the ıces of formic aldehyde which they received in ocess of smoking.

Mr. KERSTEN thought Mr. Cassal was rather ıssed on this question, and he could not agree with . Dudfield that milk was the most important item ncerned. England imported between £20,000,000 d £25,000,000 worth of preserved food products, d the use of preservatives had been increasing year year. Formerly, salt only, or chiefly, was used as preservative; but of late the demand had been for at more mildly salted, and other agents had been ed. The bulk of the butter imported from Australia s treated with preservative, and it was stated in paper that a sample treated with boric acid and t stood highest on the list for quality. He had t received a paper containing an account of an outeak of thrush amongst the children at the German ospital, which had been rapidly cured by boracic d.

Mr. D. LLOYD HOWARD said formerly benzoic acid s largely used as a preservative, but it had fallen out of use probably because of the high cost of acid when obtained from the natural vegetable source, and people were naturally averse to using the acid prepared from another source, which was hinted at. It had been long known that both soda and potash salts were necessary to health. Cattle liked to lick rock salt probably because their vegetable diet contained an excessive amount of potash and very little soda, and sailors, on long voyages, longed for vegetables for precisely the converse reason; their system was saturated with soda salts, and they required some potash to counterbalance it. A sharp distinction should be made between the use of preservatives in milk and in solid food, because the former was chiefly given to infants. Many seemed to think that the only alternative to milk with boric acid was fresh milk; but that was not so. In large towns, especially in the poorer quarters, fresh milk was unobtainable. He had frequently to spend a few minutes of an afternoon on a railway platform, where there were empty churns waiting to be returned to the farmers, and he should much doubt if the milk could have been originally treated with preservative, for the evidence of the remains being in a putrescent condition was very strong indeed. Milk must become unwholesome long before any inspector would condemn it as putrid; and that condition it was very desirable to avoid. If a preservative were added at all, it should be at first, so as to prevent the milk going bad. He did not see that cold storage would meet the difficulty. You required an ideal condition in the dairy farm to begin with, and then the milk must be filtered, put into a cold churn and carried in a chilled truck; after all that it would have to be stored in a cold chamber. How could you secure that in the poorer quarters of a large town? and in the meantime were you to prosecute all who gave preserved rather than putrescent milk to their customers? The case of solid food stood on different ground. For salt, butter, ham, kippered herrings, &c., preservatives had been used from time immemorial, and toxic preservatives too. Salt in excessive doses was an emetic, and potassium nitrate was a drug having a strong physiological action; personally he would rather take a large dose of borax than of potassium nitrate. The empyreumatic products which resulted from smoking, also were of a more or less toxic nature. But all these had the *cachet* of time in their favour; boric acid and the others had the disadvantage of being comparatively novel, and therefore they were tilted at by gentlemen who wished to be very energetic in the cause of the public health. With regard to the increase in infantile mortality, he would suggest that it might arise from the enormous number of young children living in the poorer suburbs of large towns, to the use of slightly sour milk, rather than of slightly preserved milk, and to the enormous increase in the use of tinned milk. He had had no opportunity of examining the oxygenated milk referred to, but he should imagine it would be too costly for use by the poor. It was only right that preservatives should be

declared, but he hoped that the new preservatives would not be condemned indiscriminately without proper evidence.

The CHAIRMAN, in summing up the discussion, said he need not reiterate what he had said as to the value of the paper, but there were one or two points which he might say a word upon to prevent any possible misconception. First, with regard to the sterilizing effect of carbonic acid in mineral waters; he had examined many such waters and found them swarming with germ life. Some of the best mineral waters were perfectly sterile, but that was because sterilized water had been used in their preparation. It was an important fact that bacteria in some cases became tolerant of antiseptics. This had been mentioned in regard to salicylic acid, but applied also to most other preservatives, as was shown by the fact that boric acid when added to milk only preserved it for a certain length of time; the antiseptics did not disappear but the bacteria became accustomed to it. The wide distribution of borates had been referred to, but it was a long step to say that that was a justification for adding boric acid to food in more than a thousand times the proportion in which it was found naturally. If you took a sufficient quantity of any substance you could probably find traces of arsenic and copper in it, but you could not use that as an argument in favour of adding arsenic or copper to food. The same with formaldehyde in growing leaves; this substance was probably the first product of the assimilative work of the plant, but it was immediately re-converted, and a very minute quantity was known to be a virulent leaf poison. Dr. Attfield had given a most interesting contribution to the discussion, but it was not fair to argue as Mr. Kersten had done, that because a certain article was an excellent drug, or an admirable cure for thrush, that therefore it should be added to the food of people who had neither indigestion nor thrush. Dr. Attfield consulted the highest medical authorities, and on their advice took moderate, carefully selected doses of certain drugs, which proved beneficial, but did that justify a milkman, jam maker, wine merchant, or brewer constituting himself a physician, and administering drugs to his customers according to his own judgment; whether they approved of it, or even knew it, or not. Ham, bacon, and kippered herrings were not parallel cases, because everyone knew they had been salted or smoked, they bore their own label, and those who found that such articles disagreeed with them could avoid them; but with the preservatives now used, neither sight, taste, or smell advertised their presence; they were swallowed unwittingly, and their effects could not be guaranteed against. He had no doubt that in the majority of cases no evil effects were produced, but in some cases they were harmful, and it was not desirable that drugs should be mixed with food. No reference had been made to the fact that almost every civilised State in Europe and some semi-civilised States in South America had found it necessary to legislate against the abuse of preservatives. In some places the law was more drastic than in others. Denmark, for instance, forbade their use absolutely. France condemned the use of boric acid, and would not allow butter containing it to be sold to Frenchmen, but allowed French manufacturers to mix it with food to be exported across the Channel, so that all French butter which came to England was preserved, but none of that which was sold retail in France. If there was no objection to it, why should they protect their own citizens against its use? In this respect the example had been set by England in the Sale of Food and Drugs Act, 1875, which said that tea too bad to be used in England might be exported. His own feeling was very strong that of late years preservatives had been introduced into almost every article of food and that it could not be imagined that the continual absorption of even a mild drug was desirable.

Dr. RIDEAL, in reply, said he thought the views he had expressed would have been acceptable to everyone, because he had not advocated the use of preservatives, but rather that limits should be placed upon their use, and that they should in every case be notified. No ground had been shown for asserting that such regulations would not meet the case. He agreed that large quantities of chemicals undeclared, were injurious, and he rather thought the discussion would have turned on the limits which should be imposed. The limit he suggested was four grains of borax to a pint of milk. He had yet to learn that boric acid, formaldehyde or any preservative, could be a cause of infantile diarrhœa; the majority of medical men agreed that it was an infectious disease, due to the presence of a germ, and, if so, the presence of any preservative in milk would, *prima facie*, tend to inhibit its growth. The question of the necessity for adding preservatives had, of course, cropped up, and, as was to be expected, refrigeration and heat were referred to as the proper means of effecting sterilization. It was now admitted, however, that milk sterilized by heat was not so wholesome, and he submitted that it would be impossible to supply a large town with milk sterilized by refrigeration. Apart from the difficulties attending the bringing refrigerated milk into the vendor's shop, and keeping it there, there was the question of keeping it in the consumer's house. Milk delivered in the evening had to be used for early breakfasts next morning, and refrigerated milk would not keep for that length of time under the conditions prevailing in many houses. Some time ago he examined samples of oxygenated milk, one of which he found to contain boric acid, probably unknown to the experimenter; but he understood that even when the milk was pure, either before or after the addition of the oxygen, the milk was raised to nearly the boiling point, so that the sterilizing effect was not due to the oxygen alone, at any rate

ides, oxygen or carbonic acid was a chemical, and he principles which had been laid down their use ht not to be permitted. He was glad the Chair- had referred to the importance of mineral waters g sterilized before manufacture, because they were n consumed soon afterwards. Even if not so lized, if the carbonic acid were kept in contact it a sufficiently long time, it had a sterilizing t, and the number of organisms greatly dimin- d. It was obviously desirable, however, that it ld be sterilized in the first instance.

he CHAIRMAN then proposed a hearty vote of ks to Dr. Rideal, which was carried unanimously, the meeting adjourned.

Miscellaneous.

N AND STEEL MANUFACTURE IN INDIA.

ajor Mahon has drawn up an important re- containing such information as was available, ing upon the subject of the possibility of India oming a great steel manufacturing country.*

he author considers that the present is the most urable time to commence operations in the manu- re, and regrets that the great revival in the trade, which commenced in 1898, should have d India still unprepared to take her part in it. believes that a scheme for the establishment of l works must contemplate manufacture on a iderable scale, and must include ownership not of the works but of every one of the sources upply upon which they depend, and the means which the supplies are conveyed.

he whole of the mechanical operations connected the manufacture of steel, from the casting of iron to the rolling of finished steel bars are dy in operation in India, although on a small , and Major Mahon assumes that the experi- gained is sufficient to enable it to be de- ly asserted that native labour can be trained n out-turn on any scale, and that there is no mountable difficulty in maintaining a healthy energetic European supervision.

e author discusses in the different sections of eport—(1) The fuel available in India, (2) The ores, (3) The limestones, (4) Coke obtainable Indian coal, (5) Question of site, (6) Trade and able nature of output required in India, (1) Cost ut-turn. In three appendixes the author deals (1) Experiments made to test the coking quality of Indian coals, (2) The Porto Novo Iron Company and its founder, Mr. Josiah Marshal Heath, (4) Madras Harbour, and (5) Port Canning.

There is some difficulty in obtaining full particulars of the iron ores of India, because, except in a few isolated cases, these have not been utilised, and have only been examined in a general way. Major Mahon enters fully into the question, and divides India into three available areas—eastern, central, and southern. He gives an estimate as to the quantity that may be obtained from each area, and an analysis as to quality. He considers that the ores of the Madras Presidency are, in point of quality, the most important in India.

With respect to the supply of limestone for the furnace charge, Major Mahon finds the available information somewhat meagre. Mr. Ball, in his "Geology," says:—"Limestones can hardly be said to be absent from any of the formations of India, though in some they are either rare or so impure as hardly to deserve the title." Limestone occurs in inexhaustible quantity in the island of Ramri, and several of the other islands of the Arakan coast." "Also to the south of Sandoway, at a place called Bamni, there is an inexhaustible supply of excellent limestone, which is so situated as to be easy of access by large vessels adapted to the coasting trade." "Excellent lime at comparatively small cost would be available from the Andaman Islands, obtainable from the large deposits of sea shells which are to be found on the shores." Major Mahon says that there is little doubt but that the creation of a demand for pure limestone will be followed by the discovery of fresh supplies of this not uncommon rock.

The most important question connected with manufacture of iron and steel in India is that of the availability of fuel. With a single exception (the Barrakar ironworks) all attempts made hitherto in India to establish an iron industry have contemplated the use of charcoal as a means of reduction of the ore, and these attempts have failed chiefly on account of the insufficiency of the charcoal supply. America, which is still the largest producer of charcoal iron, is rapidly transforming furnaces to the use of coke. Major Mahon writes:—"Suppose for a moment that the requirements of a modern steel works with an output of 300,000 tons annually had to be provided for, allowing one ton of charcoal as required per ton of pig, the output would necessitate in the immediate neighbourhood of the work 4,700 square miles of forest, and no such continuous area of suitable forest is available." Under these circumstances the author proceeds to discuss the amount of Indian coal available and its coking properties. After treating of the eastern, central, and southern coal fields, he comes to the conclusion that there is an ample supply in available districts, and therefore at a reasonable cost. The great difficulty, however, is connected with the production of a satisfactory coke. In March, 1898, one hundred tons of Bengal

* A Report upon the Manufacture of Iron and Steel dia," by Major R. H. Mahon, R.A., late Superin- nt Government Ordnance Factories, Cossipore. Simla, rnment Central Printing-office, 1899.

coal were sent to England for the purpose of determining whether it was capable of producing a fuel suitable for metallurgical purposes, and this was reported on by Messrs. Bolckow, Vaughan, and Co. in the following July. The result of the trials was unsatisfactory. In the first trial 40 tons were washed in a Robinson washer, and coked in Coppée ovens. The resulting coke was reported as soft and friable, quite unsuited for smelting purposes, and containing 23 per cent. of ash. In the second trial 30 tons were washed in a Robinson washer, and coked in beehive ovens; the coke was more compact and sound, but fell short of what is considered to be fair smelting coke. The ash was a little under 17 per cent. Major Mahon afterwards found that the coal sent was not of the quality ordered, and that it had lain in a stock yard in Calcutta for upwards of six months. In consequence of these unsatisfactory results Major Mahon arranged for a further series of trials on specimens of coal truly representing the seams from which they were drawn, and the samples arrived in England in February and March, 1899. A full account of the various trials is given, and the author sums up the results as follows:—"The conclusion which I draw from the foregoing trials is that the quality of the coke produced from coal in India can be immensely improved. In the case of Giridhi coal, a quality of coke is capable of being produced which would rank in a high class in any country, The Jherria coal, as judged by the Kenwadih trial, will produce a coke of a quality not much inferior. The Raniganj-Barakar coals, at all events those of the softer varieties, cannot be so definitely described; further experience and trials are necessary in their case, but I have every confidence that in those also improved results are possible. For the purpose immediately in view, viz., to demonstrate that a coke suitable for the blast furnace can be manufactured from Indian coal, enough has, I think, been done to show that a hard, tough, bright coke, very free from sulphur, and containing from 10 per cent. to 12 per cent. of ash, can be produced."

Further trials can be carried on in India, and "the principal matter yet to be determined is the cost of washing, and the loss of useful carbon incurred in the process."

The author having thus dealt with the production of the necessary fuel, and the amount of iron ore available, proceeds to discuss the question of the site most suitable for the works, and comes to the conclusion that it should be in the neighbourhood of Calcutta. He believes that to be successful the works would have to be planned on a scale equal to an out-turn of between 300,000 and 400,000 tons annually, and equipped with plant thoroughly modern in every detail, while it would be essential for the management to consist of persons combining expert knowledge with local experience. After an elaborate calculation of the cost of out-turn, he considers that the results are sufficient to warrant the belief that a well-managed enterprise would be remunerative.

AUSTRALIAN COFFEE CULTIVATION.

The north-eastern and semi-tropical regions New South Wales are remarkable for the possessi of soil and climatic condition which have ma practicable the successful production of crops n popularly associated with Australian agricultu Thus, at the present time there are 24,759 ac under sugar cane, of which the last season's cr produced 289,206 tons. At New Italy, a settleme founded by a number of Italian families, silk cultiv tion is systematically carried on; and in other plac agricultural industries of a semi-tropical charact have made a successful, although unpretentio beginning. Among these is coffee production, t berry being found equal to the best imported; y although the coffee plant is grown largely for priv use, no attempt has yet been made to utilise it co mercially.

A doubt was expressed lest the light frosts whi occasionally visited the districts would not pr detrimental to coffee cultivation, but an offic report, issued in 1898, stated that the soil and clim of the Richmond, Clarence, and Tweed river distri were all that could be desired, as were also t specimens of coffee trees which were to be seen the these being strong, healthy, and well-grown, and many instances laden with full crops. It was s prising, the report stated, that the industry had progressed beyond the experimental stage.

Although the plant has been grown in a haphaz manner, and by persons not sufficiently acquain with the proper methods of cultivation, the res obtained have been remarkable. From three f trees on one of the farms, the yield of berrie weighed by the expert making the report—was 18 or, allowing 1 lb. for parchment skin, 17 lb. of cl coffee—over 5 lb. per tree. On another farm trees bore at the rate of 4 to 7 lb. per tree. 5 lb. tree would give about 53 cwt. per acre, or—at £4 cwt. in London—coffee to the value of more t £200. On the coffee plantations in Ceylon, 1 lb. tree—1,200 trees to the acre—or just over 10 cwt. acre, is considered a heavy crop.

From a private estate at Grafton, on the Clare River, where, contrary to the practice on plantati the trees have been allowed to grow to their height—12 or 14 feet—the household, as well many of the friends of the grower, has been supp with coffee for years. The trees in the dist visited by the expert have been growing for ye and there are no signs of leaf disease or any kin blight.

As there is evidence that there will be a l colonial demand shortly for coffee plants, a nur has been prepared at the State Experimental F at Wollongbar, and a small area has also been out as a plantation. Similar preparations have made elsewhere, and one cultivator, who had getting heavy crops off a few trees for the last e or ten years, has now a plantation of 1,000 t

ich are in their third year and about to bear the st crop.

No return, for obvious reasons, has been furnished the area under coffee, or the quantity of produce tained, but both are known to be sufficiently large justify the inference that coffee, like sugar, is stined to become one of the future staple industries the north-eastern portion of the colony.

It has been suggested that the Colonial Government should establish a plantation near Grafton, on Clarence River, and another on the Tweed, for purpose of instructing the growers; but as the pression is gaining ground that there is money in fee-growing, the industry will probably fight its y unassisted. Of course, the employment of coolie our in Ceylon makes the cost of production there y much lower than it could possibly be in New uth Wales; but this would be counterbalanced by heavier yields in the colony.

Small plantations, of, say, 5 acres, could be worked hout machinery, but larger plantations require ping machinery, fermenting and washing cisterns, . A disc pulper sufficient for a crop of 25 or 30 es can be purchased and laid down for about £17. e number of plants put in is about 1,200 to the e, and for pulping and washing the crop a water pply should be available.

The net importations of raw coffee into New South ales during 1898 amounted to 738,142 lbs., valued £23,772; and prepared coffee was imported to the ue of about £2,487. The use of coffee in Australia not general, but is gradually extending, especially the cities and larger townships.

Correspondence.

TYMOLOGY OF AFRICA AND OPHIR.

have read, with interest, Sir George Birdwood's icism on my Ophir theory, published in your *urnal* of March 16, and I beg to hand you my k on "King Solomon's Golden Ophir," for Sir orge Birdwood.

He will see from the contents of this book that I s well aware of some of the facts he brings forward inst my theory when I wrote that book. On e 67, I say:—

"It must be observed that primarily the Latin ne 'Afer' for African was applied to the inhitants of the Phœnico-Carthaginian Province, l was only in a later period extended to the ire Continent. We may be sure not to err, en we assume, that the Romans adopted this ne during their earliest relations with Phœnicians l Carthaginians."

am of opinion that the ancient Semites applied name to the whole of the continent, but the ins formed their adjective from the part with ich they were in intercourse, viz., Carthage, and extended it from this part by and bye over the whole of Africa.

I may mention that also another distinct part of Africa, with which the Arabs were in intercourse, bears the name "Afer," viz., the coast opposite the south-west of Arabia, was inhabited by the tribe "Afer," the "Danakil" of to-day. A third spot was "Sofala" or "Sofara" in the south-east, and our "Afur" on the Zambesi. From this I gather that the Semites, whenever they had intercourse with Africa, spoke of "Afer," so that the local names really prove nothing but that "Afer" or "Ophir" was a general name for the whole continent.

What Sir George Birdwood says about the Indian roots of the names of the goods of the Ophir voyages, is very interesting. But if he will take the trouble to look over page 39 to 45 of my book, he will find that I was acquainted with this theory, which, however, I consider wrong. I think it more probable that the Hebrew language derived these names from the Egyptians. "Tukkhiim," which Sir George Birdwood translates peacocks, were most likely guinea-fowls, "Tucca" being the name for guinea-fowls in certain parts of Africa. "Algumim" is not Sandal-wood, as this tree is mentioned as providing timber for Solomon's Temple. I think we have in this word the root "Gum," "al" being the article, and "im" the plural form. Where it is mentioned as "timber," it means undoubtedly "Cedars," and, I should say, was generally used for noble trees in the Old Testament. Luther translates it as "Ebony."

I mention these facts just to prove that the Indian Ophir theory can not be based on the philological derivation of the names, as this derivation is open to controversy.

I shall be pleased to see what Sir George Birdwood may have to say to my conclusions when he has read my book, and I am obliged to him for the valuable remarks which he sets forth in your issue of March 16th, and which have my fullest attention.

CARL PETERS.

Moorgate Station Chambers,
London, E.C.,
March 20, 1900.

General Notes.

THE ITALIAN VINTAGE.—According to a recent report of the German Consul-General at Naples, the Italian vintage of last year amounted to 699,000,000 gallons, the figures for the three preceding years being 723,800,000 gallons, 622,600,000 gallons, and 629,200,000 gallons respectively. Of the total for 1899, 167,200,000 gallons came from North Italy, 154,000,000 from Central Italy, 263,000,000 from Southern Italy, 96,800,000 from Sicily, and 28,600,000 gallons from Sardinia. In certain districts in Apulia

the vintage has been remarkably good. The export of wine from Italy during the first eleven months of 1899 amounted to about 46,200,000 gallons, about half of which went to Austria-Hungary.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MARCH 28.—"Leather for Bookbinding." By DOUGLAS COCKERELL. RICHARD GARNETT, C.B., LL.D., will preside.

APRIL 4.—"Cotton Supplies." By JOHN A. BANISTER.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MARCH 29.—"The Cultivation, Manufacture, and Use of Indigo—Position of the Industry in India." By CHRISTOPHER RAWSON, F.I.C. SIR WILLIAM BRERETON HUDSON, K.C.I.E., will preside.

APRIL 26.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L., Deputy Judge Advocate-General. The Right Hon. SIR FRANCIS HENRY JEUNE, K.C.B., D.C.L., will preside.

FOREIGN AND COLONIAL SECTION.

At 4.30 o'clock:—

APRIL 2 (Monday).—"The Century in our Colonies." By the Right Hon. SIR CHARLES WENTWORTH DILKE, Bart., M.P. The Right Hon. LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., LL.D., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

APRIL 3.—"Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

E. SANGER SHEPHERD, "Photography of Colour." Four Lectures.

LECTURE IV.—MARCH 26.

The Application of the Trichromatic Method of Colour Photography to the Printing Press.—Light filters—Suitable plates and negatives—Preparation of the printing surfaces—The half-tone process, its faults and difficulties—Inks—The printing of the three impressions—Colour-printing machinery.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. E. Sanger Shepherd, "Photography of Colour." (Lecture IV.)

Imperial Institute, South Kensington, S.W., 8½ p Mr. H. F. Wyatt, "The Navy and the Empire.

Surveyors, 12, Great George-street, S.W., 8 p Mr. J. H. Sabin, "The Incidence of Imperial Local Taxation on Rateable Property."

Actuaries, Staples-inn Hall, Holborn, 5½ p.m.

Camera Club, Charing-cross-road, W.C., 8½ p Mr. Everard im Thurn, "The Land and Peopl Guiana."

Medical, 11, Chandos-street, W., 8½ p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p Mr. W. F. Shaw, "The Position of the Organs the Body in Animals."

TUESDAY, MARCH 27...Royal Institution, Albemarle-str W., 3 p.m. Prof. E. Ray Lankester, "The Str ture and Classification of Fishes." (Lecture X

Childhood Society, 74A, Margaret-street, W., 8 p Prof. Sidney H. Wells, "Science Teaching."

Medical and Chirurgical, 20, Hanover-square, 8½ p.m.

Civil Engineers, 25, Great George-street, S.W p.m. Discussion on paper by Mr. F. W. Bid "The Great Central Railway Extension—North Extension," and by Mr. F. Douglas Fox, " Great Central Railway Extension—Southern D sion."

Photographic, 66, Russell-square, W.C., 8 (Technical Meeting.) Mr. A. Watkins, "S Developers Compared."

Anthropological, 3, Hanover-square, W., 8½ p.m

WEDNESDAY, MARCH 28...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. Mr. Douglas Cocke "Leather for Bookbinding."

Royal Society of Literature, 20, Hanover-squ W., 1 p.m.

Patent Agents, 19, Southampton-buildings, W 7½ p.m. 1. Discussion on Mr. J. Imray's pa "Subject-Matter of a Patent." 2. Papers communications on "Compulsory Working," foreign members.

British Astronomical, Sion College, Victo embankment, E.C., 5 p.m.

Mining and Metallurgy, Geological Mus Jermyn-street, S.W., 8 p.m. 1. Mr. Her C. Hoover, "Metal Mining in the Province Chi-li and Shantung, China." 2. Mr. John Powell, "Gold Mining in British Guiana." Mr. F. H. Probert, "Notes on the Lake o Woods District."

THURSDAY, MARCH 29...SOCIETY OF ARTS, John-st Adelphi, W.C., 4½ p.m. (Indian Section.) Christopher Rawson, "The Cultivation, M facture, and Use of Indigo—Position of the Ind in India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 3 p.m. Ar General Meeting.

Royal Institution, Albemarle-street, W., 3 Mr. H. J. Mackinder, "Equatorial East A and Mount Kenya." (Lecture II.)

Camera Club, Charing-cross-road, W.C., 8½ Mr. A. Burchett, "The Arrangement and struction of Picture Landscape."

Monumental Brass Society, 32, Sackville-street 7½ p.m. "Brasses of Founders of Schools."

FRIDAY, MARCH 30...Royal Institution, Albemarle-street 8 p.m. Weekly Meeting, 9 p.m. Prof. Thomson, "Facts of Inheritance."

SATURDAY, MARCH 31...Royal Institution, Albemarle-s W., 3 p.m. Lord Rayleigh, "Polarized Li (Lecture IV.)

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FRIDAY, MARCH 30, 1900.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

Mr. E. Sanger Shepherd delivered the urth and last lecture of his course on "Photo-aphy of Colour," on Monday evening, 26th st.

On the motion of the Chairman, a cordial te of thanks was passed to the lecturer for s course.

The lectures will be published in the *ournal* during the summer recess.

PROF. FLEMING'S CANTOR LECTURES.

The course of Cantor lectures by Prof. mes A. Fleming, D.Sc., F.R.S., on Electric Oscillations and Electric Waves," nounced for delivery on May 7, 14, and 21, ll of necessity have to be postponed in con-quence of the lecturer being unexpectedly mmoned to America.

The arrangements to be made in conse-ence of this alteration in the Society's cture Programme will be announced later.

INDIAN SECTION.

Thursday, March 29, 1900; Sir William ereton Hudson, K.C.I.E., in the chair. e paper read was on "The Cultivation, anufacture, and Uses of Indigo," by Chris-pher Rawson, F.I.C.

The paper and report of the discussion will published in the next number of the *urnal.*

Proceedings of the Society.

SEVENTEENTH ORDINARY MEETING.

Wednesday, March 28, 1900; Richard Garnett, C.B., LL.D., in the chair.

The following candidates were proposed for election as members of the Society:—

Gilman, Edward Philip Reuben, Burdwar, Palasbari P.O., Assam, India.
Gordon-Parker, Dr. J., Herold's Institute, Drummond-road, Bermondsey, S.E.
Jackson, Sir Thomas, Hong-Kong, China.
King, D., Bank of Calcutta, Limited, Calcutta, India.
McMechan, Samuel J., Beech-hill, Kersal, Manchester.
Mistri, N. R., 4, Bruce-lane, Fort, Bombay, India.
Reid, David, Shootfield, Sundridge, Sevenoaks, Kent.
Shorland, E. H., Drake-street Works, Stratford-road, Manchester.
Spence, Horace Robert, 3, Lexham-road, Colchester.
Turri, George G., Salisbury-building, Queen and Bourke-street, Melbourne, Australia.
Vecqueray, Arthur Hermann, British Consulate, Cadiz, Spain.
Waters, Lieut.-Col. George, I.M.S, Bombay, India.
Zilz, Henry, 22, Bush-lane, Cannon-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Ashworth, Captain P., R.E., Akola, Berar, India.
Deas, James, Municipal Offices, Warrington.
Hammond, John Hays, 43, Threadneedle-street, E.C.
Hedderwick, James David, J.P., 2, Clairmont-gardens, Glasgow.
Morrison, Gabriel James, 16, The Bund, Shanghai, China.

The paper read was—

LEATHER FOR BOOKBINDING.

By Douglas Cockerell.

The Council of the Society of Arts having decided to appoint a Committee to investigate and report upon the subject of Leather for Bookbinding, I have been asked to explain the reasons that make such a report advisable.

Everybody who has to do with bound books knows that much of the leather binding of the 19th century is in a very bad state. On every hand complaints of the rapid decay of bindings are heard, and it is unusual to examine a library of any size without finding the leather

on a large number of the books bound during the last 50 years has perished.

On the table will be found some books selected from the library of the Society of Arts, on which the leather has become absolutely rotten, and in almost every considerable library I know hundreds of such examples could be found.

If any book is much used there will come a time when the soundest leather will wear out at the points most exposed to friction, but the complaint is not of such legitimate wear, but of the disintegration of the leather itself.

If such damage as is shown by the books before us had been caused by use, the leather, where not exposed to friction, would have remained sound; but such is not found to be the case. If these or other similar bindings be carefully examined, it will be found that the leather has utterly perished, and lost all those qualities such as toughness and flexibility that make it a suitable material for the binding of books.

As a bookbinder such damaged leather comes constantly under my notice. It naturally occurred to me that it might be possible that the leather I was using for the repair of the backs of perished bindings might wear no better than that which it replaced. Some analytical investigations made by various scientific friends of mine confirmed my fears.

Early last year a meeting of some dozen men, who had become interested in the matter, was arranged to take place at the Central School of Arts and Crafts, in Regent-street, under the chairmanship of my former master, Mr. Cobden-Sanderson.

This meeting formed itself into "a committee to encourage the production of sound and durable leather for bookbinding."

After we had met once or twice, and a good deal of investigating and experimenting had been done by various members, it was found that the subject was too large a one for such a committee to deal with adequately, and so, on the motion of Lord Cobham, it was decided to approach the Society of Arts, with a view to inducing them to undertake a thorough investigation, and to issue such a report as was published at the end of their inquiry into the cause of the deterioration of paper.

The Council of the Society of Arts approved of our suggestion, and the committee has been, or is about to be appointed, and all who are interested in leather bindings can look forward with interest to the publishing of their report.

I shall now try to put before you the present state of the question showing what has be done and suggesting what there is yet to do.

If the damage noticed in leather bindin were confined to isolated cases or even isolated libraries it might be thought to be t result of some special circumstances or ac dent, but when it is found, as it is found, th a large proportion of the leather bindings most libraries have perished, we must seek some common cause for the injury.

Various theories have been advanced fr time to time and some of those most genera accepted I shall briefly mention.

We will first consider the theories th suppose the damage to have taken place aft the books have been placed in the librar These are chiefly that the injury is caused damp, by excessive heat, or by the fumes fr the burning of coal gas.

Damp, as far as I have been able to asc tain, is not nearly so injurious to leather excessive dryness. In extreme cases whe books are kept in a confined, damp spa where air cannot freely circulate, the grow of mildew will be encouraged. Although t is undoubtedly injurious, it is not the bindin that are exposed to damp, but rather tho exposed to excessive heat that first sh damage like those on the table.

The soundest vegetable-tanned leather wh exposed in an oven for even a short time, to temperature exceeding 100° Cent. loses flexibility and toughness. It appears to the case that a long exposure to the lower b still excessive dry heat to which books a subject in the upper shelves of most librari tends to the same result. On this account is advisable to pay great attention to top ve tilation in libraries, and where the source heat is a system of pipes or hot air, to ado means to prevent the air from becoming t dry. This heat theory would account for t damage were it not that older bindings th have been exposed to the same conditions a often found comparatively uninjured side side with those on which the leather is utte rotten. So it will be necessary to look for t reason that has rendered these damaged bin ings specially susceptible to the effects of he

From time to time chemists have been co sulted, with the result that analysis shew that there was nearly always a considera quantity of free sulphuric acid present in t leathers that had perished. As sulphur acid (becoming after a time sulphuric a by absorption of oxygen from the air) one of the substances given off when c

as is burnt, the theory that the damage was ıused by gas was arrived at.

The following extracts from the report of the ɔnference of the Library Association held : Birmingham in 1887, shows that the gas ıeory was not a new one at that time :—

"The time-worn theory of the effect of gas upon ıther bindings was introduced by two or three eakers. Mr. J. C. Woodward announced that on bmitting some bindings to an analysis he was surised to find that they yielded sulphuric acid in the oportion of 12 per cent. (?) to the weight of the ıther. Professor Tilden of the Mason College of ience, said it is naturally the books on the upper d topmost shelves that suffer most. A film of oist exhalation from the fumes of gas settles slowly ı the tops of the books and, evaporating, leaves a posit of sulphuric acid which gradually destroys ɔth leather and paper. In order to secure the better eservation of books, and to nullify the ill-effects of s, it is extremely desirable that more careful ventilaɔn should be provided in libraries than is now comonly the case."

It is no wonder that this theory was eagerly cepted by everybody concerned, as it ablved them all from blame. When complaints re made to the bookbinder of the decay of e leather, he escaped all responsibllity by aming the gas, and the manufacturers did e same. It was as satisfactory as blaming e cat for domestic breakages. It was nody's fault, a sort of law of nature, which is rd, but must be put up with. Librarians emed to say, "We must have books, and we ıst have gas, and if the two do not go gether it is clearly not our fault," and so thing was done. Unfortunately for this mfortable theory it was found that the early cay of binding, and the presence of sulphuric id in the leather, were not peculiar to raries in which gas was used.

At a meeting of our committee Mr. W. J. ighton showed a half-bound book in dark een, hard-grained morocco, bound in 1883, ıt had been kept on a shelf without much e, the leather of which had rotted utterly. ıis he stated could not be the effect of gas there was only electric light in the library.

Mr. Cyril Davenport said that bindings in e British Museum showed similar decay, d that they had neither gas or electric light.

That the fumes of burnt gas are likely to be some degree injurious to leather is admitted, d is an additional reason for paying attenn to the proper ventilation of libraries. t the evidence quoted seems to show consively that the gas theory will not account all the damage, nor for the presence of sulphuric acid in leather not exposed to gas fumes.

In June of last year I submitted to an eminent firm of leather manufacturers samples of all the various leathers I was using for bookbinding, and their report was :—"I have carefully tested and analysed the sample pieces of leather collected from your place . . . . with the result that all with the exception of the African lêather contain free sulphuric acid."

Dr. Gordon-Parker, Director of the Leathersellers' Company's Tanning School at Bermondsey, was also kind enough to test samples of various leathers, and I find on the minutes of our committee's first meeting that :—"Dr. Parker stated that he had tested samples of Levant morocco submitted to him, and that they had not stood the tests as sound leather should."

The samples were in both cases cut from leather I was using in my workshop at the time, leather of the most expensive sort to be got in London. The African leather, mentioned as being the only sample free from sulphuric acid, is brought from some hundreds of miles up the Niger by the Royal Niger Company, and is, I think, one of the best leathers now obtainable for bookbinding. As it appears from this evidence that sulphuric acid is present in the leather before it is used to cover books, it will be obvious that it is in the process of manufacture that we must look for its introduction.

As we are now entering upon somewhat technical ground, I will briefly enumerate the processes through which such a skin as this (sumac-tanned morocco) goes while it is being converted from the natural skin, liable to very rapid decay, to what should be almost imperishable leather.

The skin from which this leather is made is that of a South African goat. The salted skin would be received by the European tanner, and by him soaked in water for several days to soften it. It would then be scraped with a knife on the flesh side to further soften it, and to remove any fleshy matters that would interfere with the action of the lime liquor. In order to loosen the hair the skin would next be limed. It would be placed in old lime liquor for two or three days, then taken out or drawn for a few hours, then placed in stronger lime liquor for several days and frequently drawn as before. It would then be placed in strong lime liquor with frequent handling or drawing until the epidermis readily yielded to the touch.

The skin would then be laid on a sloping block of wood called "a beam," and scraped on the grain side with a long two-handled knife to remove the hair, and on the flesh side to remove any inequalities that may remain.

The next process is to remove the lime as its presence would interfere with the subsequent tannage. The most usual method of doing this is to steep the skins in a liquid containing dogs' dung called a "puer." This unpleasant process, not only so acts on the lime as to make it possible for it to be readily washed out, but also has an important bacteriological effect which renders the leather soft and pliable.

I see that both Professor Procter and Dr. Parker are confident that some uninjurious process is on the point of being generally introduced, that will do away with this "dangerous and disgusting process which has long been a trouble and a disgrace to the tanner."

The puering would be followed by a bran drench to cleanse the skins and complete the removal of the lime. After this the skin would be probably scraped on both sides and soaked in water. The skin, by the previous operations rendered porous, is now called a pelt.

A morocco skin such as this would probably be tanned with sumac. One method of sumac-tanning called bottle tanning is somewhat as follows:—The pelts are sewn up into bags, are nearly filled with strong sumac solution and are floated in a tank containing a warm weak solution of sumac. They are kept in constant motion for two or three hours, and are then removed and piled in a heap when their own weight forces the sumac solution through the skins. These operations are then repeated.

After the second piling the bags are unsewn, and any sediment that may be left removed. The tanned pelts are then thoroughly washed, and are laid out on a board and "struck," that is scraped and rubbed until perfectly smooth. They would then be hung up to dry, and when dry they are said to be in the "crust," and are hard and shrivelled. To render them smooth they are again softened and scoured, and are then ready for the dye house.

Sumac is considered a good tannage but produces a less tough leather than bark.

Whether bark or sumac has bsen used for the tanning the skin has now become leather, and the subsequent processes do not add to its strength, but are for the sake of appearance and to give a high finish. It is in these operations that most of the damage noticed is done.

Skins of animals, not being manufacture articles, vary in texture and thickness i different parts, and if put into the dye bath o paddle as they come from the tan-pits woul not take the dye evenly.

The slight unevenness of colour resulting is great gain artistically. The demand fo absolutely flat, even, colour is an unnatura one, based on no good reasons, and yet it i this very evenness of colour to get whic strength and durability are sacrificed, that i quoted as one of the evidences of the moder advance in the art of tanning.

In order to get an absolutely even shade— it is necessary to "clear" the skin—that is t say, the skin must be rendered as light an even in colour as possible, before dyeing. Thi is often done with sulphuric acid, at the ris or even certainty of damage to the skin.

Dr. Gordon-Parker, in a paper read befor the British Association at Bristol, in 189 says:—

"One sample [of bookbinding leather] dates bac to 1658, and is sound, whereas this other samp of less than fifteen years of age, is already pract cally worthless as a binding for books. It will, daresay, have been noticed by many that boo bound with brilliantly coloured leathers, very so begin to look shabby, and the least scratch or ru bing removes the grain of the leather. This should feel inclined to attribute to the metho used for souring the skin previous to dyeing. order to produce an even bright shade, leather frequently put in a bath of sulphuric acid, and u fortunately this important process is not alwa superintended by capable technically trained me The result is, that the skins frequently go into the d bath, containing a fairly large percentage of sulphu acid which the leather has absorbed. After dyei the leather is dried out, with this sulphuric a still in the fibres, and gradually the sulphuric a eats away the fibres of the leather, causing it become rotten."

And Professor Procter in a paper on leath dyeing contributed to the January number the "Journal of the Society of Chemical I dustry," says that:—

"There is no doubt that the rapid decay of leat bookbindings and upholstery is largely due to careless use of sulphuric acid in 'clearing' and dye the leather, and even if it is fully removed it saturated all bases such as lime, which are natur present in leathers in combination with weak aci and which would otherwise act as some protect from the sulphuric acid evolved in burning coal ga

For dyeing leather coal tar dyes have pr

ally entirely superseded the old vegetable es. In aniline dyes themselves there apars to be no active harm, but they are mostly gitive, and some of them so much so that ere can be no possible excuse for employing em in dyeing leather that is to be used for rmanent bindings.

They are used because dyeing with them is comparatively easy process and by their use great variety of bright colours can be got. In der to get these bright colours it is the stom to use sulphuric acid in the dye bath. r. Fuller, of Bevington's, in evidence before r committee, stated that certain damage in me brightly coloured French levant skins uld be probably caused by the sulphuric id left in the skin after dyeing. Such acid would be used because that was the easiest y to work, and although by using about ree times as much dye you could get good lours without acid, he did not think the ightest colours could be got without acid."

Dr. Parker stated that "damage would en be caused by clearing with acid to take ains out and make the colour even, and not ashing sufficiently. Also that one ounce of e with acid would equal in effect two ounces more without acid." Dr. Parker also said at "by continuous washing, sulphuric acid uld be got out of the skin, but it was very ldom so got out. Workmen simply throw in paddle for a short time, with clear water, d trust to luck. Leather will absorb and ld as much as 15 per cent. of acid, and threearters would be washed out by water easily, d the remainder with great difficulty."

That sulphuric acid is injurious to leather acknowledged by every specialist I have nsulted. It is sometimes stated as an excuse at the acid is used in such dilute solutions at it is harmless. But as leather has the rious property of extracting from a weak lution nearly all the acid, leaving the remaing liquid neutral, it will be seen that the nount of damage does not altogether depend on the strength of the solution. Professor octer, on this point, says:—"It must be ecially noted that, as the skin is capable of king up acids from very dilute solutions, the ect, if time is allowed, will depend upon the al quantities of acid present, and not on its ncentration, so that a large volume of a ute solution may act more powerfully than a nall volume of a stronger one."

Leather in our climate contains about 15 r cent. of water. If only a small quantity sulphuric acid is left in the skin, that may in solution with the 15 per cent. of water be too weak to be immediately injurious, but if the leather is subject for any length of time to hot dry air, the water will evaporate but not the acid, so that as the leather gets dryer the solution becomes more concentrated, and at last becomes strong enough to destroy the fibres.

So that it will be seen that apart from the gas theory the presence of sulphuric acid in the fibres of perished leather is amply accounted for, as is also the more rapid destruction of the top-shelf bindings.

I have been sometimes told by chemists that it is not in the use of sulphuric acid, but in its careless use that the danger to the leather lies, and that by taking certain more or less complicated precautions the acid can be neutralised and got rid of. But what in a chemist's laboratory on a minute scale is possible, or even easy, is hardly practicable on the huge scale on which leather manufacture is now carried on. I am told that in many mills it is the custom for the work to be given out to gangs of workmen working under a foreman, who often uses more or less secret decoctions which are apt to contain most injurious ingredients. The gang would be given so many dozen skins with instructions to finish them to a given pattern, and, I fear, provided the pattern is matched, the methods by which the result is got are often but little questioned. Alexander Watt, in "The Art of Leather Manufacture," writes (page 340, "*Scouring* for Bright Colour"):—"Leather is soaked in a bath containing sulphuric, or oxalic acid, or occasionally both. In this bath, the leather is kept for a short time being constantly moved about, after which it is placed on the scouring stone, and washed with chemical solution, according to the fancy of the workman." I understand that great injury is often done to bookbinding leather in the final finishing processes, such as graining and polishing, which are sometimes done with hot plates; and, generally speaking, the processes used to produce the very high finish that has become customary tend to weaken the leather.

This high finish is quite useless for bookbinders, for in the course of covering a book the leather is damped and more or less stretched, and much of the dearly bought finish is lost. The bookbinder has, by pressing and polishing, to finish the leather himself after it is on the book. And in the case of light calf he often gets rid of the flat even

colour that the tanner has taken such pains to arrive at, by sprinkling or marbling.

So that it appears that in order to get a uniform colour, a great variety of bright shades that are acknowledged to be fugitive, and a wholly useless finish, much leather is destroyed in the process of manufacture, and that the much boasted of improvement in the appearance of modern leather for bookbinding is obtained at the expense of durability.

While those people who would prefer to do without absolute evenness of colour or high finish are looked upon as unpractical artistic faddists, those who have sacrificed to these qualities the strength of the leather are regarded as models of practical common sense.

There is an axiom often quoted among craftsmen "that materials should look like what they are." This simple rule of elementary craft honesty is in leather violated at every turn. Leather for bookbinding is so tortured and worried in finishing and graining, that most people hardly know that the various leathers have each a characteristic, and often beautiful natural grain.

We find now, that instead of leather made from sheep, calf, goat, and pig-skins, each having, when finished, its own characteristic surface, that sheepskins are got up to look like calf, morocco, or pigskin; that calf is grained to resemble morocco or so polished and flattened as to have but little character left; while goatskins are grained in any number of ways, and pigskin is often grained like levant morocco. So clever are some of these imitations that it takes a skilled expert to identify a leather when it is on a book.

When we remember that all this masquerading is done at the expense of the strength and beauty of the leather, and that quite a large proportion of the price paid for the finished article goes to pay for these injurious processes, it will be recognised that an investigation into and a report upon the subject of leather for bookbinding is sadly needed.

Who is to blame for the present condition of things, it is hard to say, nor does it greatly matter.

That the more advanced of our leather manufacturers are aware that the present state of things is unsatisfactory, and that they would be willing to go back to the old and safer methods, is shown by the fact that three important firms have at their own expense and at great trouble produced leather guaranteed to be free from anything injurious. These firms are :—Messrs. Bevingtons, of Bermondsey; Messrs. Meredith Jones, of Wrexham and Messrs. Epstein Bros., of Holborn-viaduc I am sure our thanks are due to them for the hearty co-operation in the movement. Sampl of the production of these firms will be seen o the table.

On the question of the selection of leath for bookbinding, there is not much to be sai I am inclined to consider that calf, as a soun leather, has been manufactured out of exis ence, for it is unusual to find a 19th centur calf binding of more than fifteen years old th does not show signs of decay. Russia is a bad, I think owing to the nature of th tannage, and to the use of nitric acid i finishing.

The various leathers made from sheepski nearly all wear badly, but I have seen book bound in Roller basils that have stood a goo deal of wear for twenty years without seriou injury.

Morocco is naturally a very tough leathe but, as has been said, samples of the mo highly priced kinds were condemned by D Parker, and several bindings of hard-graine morocco I have seen lately show signs decay, although they have not been very man years bound and have had but little use.

Pigskin is on the whole the strongest leath to be got, especially if used undyed as th saddlers use it. I have seen samples of dye pigskin that have perished as badly as th worst calf.

That calf, goat, sheep, and pigskin do n necessarily make rotten leathers, is seen fro the many remaining examples of old binding with these leathers that are, after hundreds years, still sound.

I have brought some 15th century bindings i calf, goat, sheep, and pigskin. In each cas although the books show in places signs wear, the leather that remains is still soun These volumes are in this respect in no wa exceptional.

The bookbinders are not wholly free fro blame for the decay of their leather. It certainly a common mistake to pare down larg thick skins for the binding of small books. would be safer to choose small skins that woul not need so much shaving for small book because the natural layers of the skin woul remain in some reasonable proportion to eac other, whereas, in the case of a large skin, ve much shaved down, you have little left but th comparatively brittle grain layer.

There is also a most injurious custom book binders have of washing up calf binding wit

ic acid. Oxalic acid, in solution, rapidly talises, and, apart from its chemical on, it has a similar disintegrating effect on leather as that of frost on damp earth. The nicals used in sprinkling and marbling are also very injurious.

should like to protest against the use ollow backs for library work. If the leather ttached to the back of the book the strain pening and shutting is distributed across back, and does not, as in the case when ow backs are used, fall entirely on the t.

have only been able to deal with the chief ts common to most bookbinding leathers. ive not touched on processes that only affect cial classes of leathers; such as black dye- with the aid of iron salts, or the preparation Russia leather, &c.

rom investigations, as far as they have n carried, it would seem that much of the her now in use for bookbinding is not likely ast for a reasonable time; that one of the f causes for its early decay is the use of phuric acid in clearing and dyeing; that ine dyes, as now used, are mostly fugitive, on that account are unsuitable for dyeing her to be used for permanent bindings; t excessive finish is not only useless to kbinders, but injurious to the leather.

his is a very serious conclusion to have ne to, and it would be more serious were not that the leather manufacturers have eady to some extent met the difficulty by ducing, at great trouble, leather they can rantee to be uninjured in the process of nufacture.

mong the chief points still remaining to be estigated are, whether aniline dyes can be dered reasonably permanent and used with- injury to the skin; whether any of the ther produced by the various processes of neral tannage is suitable for book-binding; ether modern calf and "Russia" are, by ir nature, weak leathers, or if they are ually sound materials injured in the process nanufacture; whether the use of a neutral p on leather after binding would be advis- e, and if so, what should be the nature of soap; and whether any practicable system testing and hall-marking leathers could be ablished.

n the year 1604, Parliament tried to meet iculties somewhat similar to ours, by pass- "An Act concerning tanners, curriers, emakers, and other artificers in leather," of ich part of Clause 16, reads:—

"And whereas divers tanners for greediness of gain do overmuch hasten the tanning of their leather, and for that purpose do use divers crafty and subtle practices. . . . They make their leather to seem fair and well and sufficiently tanned within a short space. . . . . Every person shall forfeit for every such offence, £10, and shall also stand upon the pillory three several market days in the market town next to the place where the said offence shall be committed."

It would be difficult to enforce such an Act now, we should need such an inconvenient number of pillories.

DISCUSSION.

Mr. Cobden Sanderson said he had much pleasure in supporting Mr. Cockerell and in endorsing what he had said with regard to leather for book-binding. The matter was one of very serious importance, it was ripe for investigation, and he hoped great things from the appointment of the committee. The points to be examined included the way in which leather was prepared now as compared with the earlier methods; and next, the conditions to which it was subjected, including the atmosphere in which it was kept, and the illuminants and other matters to which it was exposed. Leathers prepared by the same processes, but exposed to different conditions, would probably yield different results. That was obvious on comparing the backs of books in a library with their sides. It was well known that the surface of stone was gradually decomposed by the action of acid in the atmosphere, and it was often asserted that the decomposition of the leather in bindings was due in great measure, if not exclusively, to similar causes. It would be desirable to ascertain, therefore, whether leathers which seemed about the same age were in the same or in a different condition when differently placed. It was very difficult to say whether leather prepared at the present time was or was not likely to decay; it might be assumed that the presence of acid would produce decay, but it would also depend probably to some extent on the conditions to which it was exposed. With reference to dyes, they had evidence that they disappeared, a brilliant green becoming in a few years a hideous pea-soup yellow, and the same with some other colours. He quite agreed that the finishing was carried too far. Flaws and irregularities were not agreeable in themselves, and should be avoided if possible, but one might go too far in search of refinement, as one certainly did when the leather was injured by processes for disguising or eliminating flaws; the same thing led to excessive paring. He thought it would be a good thing to have a permanent committee, consisting of persons interested in books—the paper-maker, the printer, the publisher, and the binder—and he trusted some such committee to look after the general welfare

of books would arise out of the present movement. He congratulated Mr. Cockerell on being the pioneer in this matter, and on having taken it up in such a large spirit. The bookbinder would now be led to look at his craft from all points of view, and to take more interest in the materials he used, acting with regard to each so as to see that it was good of its kind. It was gratifying to find that leather manufacturers were anxious to produce what was required, and he hoped some method of hall-marking would be found feasible, as it was impossible for the binder to investigate on each occasion the quality of the skins he purchased.

Mr. Cyril Davenport said there was no doubt that modern leathers, instead of being the best material for binding, were often the worst; and librarians would do well to substitute buckram or cloth for calf and roan. He believed this was chiefly due to the use of aniline dyes, as their absorption seemed to require the addition of sulphuric acid. He could corroborate Mr. Cockerell's statement as to the durability of the old pigskin; there were plenty of specimens of the 15th century still perfectly sound. There was also plenty of Italian work of the late 15th century, in red morocco, which was quite good; the red was not bright, but crimson. He did not know the dye used—possibly cochineal, or some vegetable dye. Several of the early books were very dark green or black; but he did not think that a bright green was found in any old specimens. A bookbinder ought to be able to refuse to buy any leather without a written guarantee that it was free from sulphuric acid, but that would not come until leathers were marked. The difficulty was that the general public would have brilliant colours. He should like to know what dye was used for the Niger skins, which certainly were excellent. He agreed in the condemnation of hollow backs, and he could say from experience that books kept in a glass case lasted better than if they were exposed to the air, provided there was no damp in the case, for that would soon cause rottenness.

Mr. W. J. Leighton said his experience in many libraries had been that heat was the great destroyer. He had one in his mind, where there was hardly any ventilation, in which the books looked as though they had been in a furnace.

Dr. Gordon-Parker said he could support a great many of the statements in the paper; but perhaps the author had laid rather too much stress on the dyeing process and the use of sulphuric acid. In many cases, when leather rotted, the evil commenced long before it reached the dye-house. He believed that over-liming, or the use of too stale or putrid limes, weakened the skins to an enormous extent; and again, in the disgusting process known as puering, the skins were often injured, and the fibres and fibre coats much weakened. An inv gation into this must therefore go much fu back than the dye-house. The use of sulp acid was not so much the cause of in as the carelessness in not removing it after dyeing. It was not very difficult to detect presence of sulphuric acid in leather, but lea might also be dyed by the use of bisulphates, an would not be easy to say whether any sulphuric present was not due to the use of those substa It was quite new to him that bookbinders did require highly finished leathers; his idea always that they required it more highly and carefully fini than any one else; but he quite agreed that the cess was sometimes carried too far. If the man turers knew that bookbinders did not require su perfectly even colour, or such a highly glazed fi the leather might be improved, and certainly coul sold cheaper. With regard to aniline dyes, Profe Hummel, of the Yorkshire College, Leeds, s years ago, before a Parliamentary Committee, a list of aniline dyes, which were distinctly n stable than any wood dyes known. Some them were fugitive, but many were not. Pa leather down could not be too strongly condem because it removed the true leather altoget Oxalic acid should certainly not be used in a centrated solution; and it looked as if bookbin as well as leather manufacturers, wanted a little n education. He knew something about the leat manufactured by the firms mentioned in the pa and would like to know how they could guara their skins as being up to any absolute stand Messrs. Bevington had a very good name in trade, but he had known skins of theirs to go wr and he did not see how they could guarantee thing beyond due care in the manufacture freedom from sulphuric acid. The skins mi have been so treated before ever they reac their hands that they would not last m years. It seemed to him a very good idea have skins examined and hall-marked if it coul managed. Possibly the Leathersellers' Comp which founded the tanning school in Bermondsey the school for leather dyeing, might take up matter and formulate some method by which bad sl would be condemned. A microscopical and chem examination would reveal a good deal, and he been able to condemn as bad some skins which been submitted to him. In conclusion, he would qu from a book called the "Leather Workers' Manu published by a man in the trade, two out of m recipes for decorating and colouring leather. recommended the use of a bath of strong caustic s as a preliminary to gilding, and another gave a n ture of nitric acid, salts of tin, and fuming hy chloric acid. If such recipes were used by bo binders or leather-dressers, he did not wonder t leather decayed. He hoped a strong commit would be formed, and felt sure that the leather tr would render every possible assistance.

r. H. B. WHEATLEY said the depreciation of kbinding leathers had been a burning question for y years. The first occasion he believed on which investigation was made was at the Athenæum Club ie 'forties, when Professor Faraday investigated matter very thoroughly, with the result that all the ps in the club were provided with special chimneys arry off the products of combustion, the idea then ig that the chief source of mischief was the gas-ners. Further investigation, however, showed that as probably not so much the gas itself as the heat n the gas; because the books at the United Service b, where no gas was then used, were in an even se state than those at the Athenæum. The ques- had often been brought before the Library Asso-ion, and many librarians had come to the conclu- that it would be well to give up the use of calf employ cloth and buckram. They had also great h in the strength of morocco. It was a curious t that old books of the 16th, 17th and 18th centuries, nd in calf, remained perfectly good to the present . Some specimens were on the table. Hitherto iad been generally supposed that the deterioration bindings was due to heat or bad treatment, which doubt had much to do with it, but those dangers ght be guarded against by ventilation and care. . Cockerell had drawn attention to a still greater , for if the leather was thoroughly bad in first instance, no subsequent care would prevent destruction. It was, therefore, of the greatest portance to establish some such system as Mr. ckerell advocated, and he hoped the result would that a leather would be produced on which book-ders could rely.

Ir. E. ALMACK said what they really wanted, l thought they ought to have, was leather as od as their forefathers had 250 years ago. He ed the committee would ascertain what their estors used, and what they avoided. Some two three years ago he found it was impossible to ain in London a rich red morocco, such as Samuel arne used for binding 150 years ago, and the our of which stood to this day.

Mr. S. P. EPSTEIN said no doubt books bound 150 rs ago stood the test of time much better than se recently bound, but the conditions were entirely nged. In those days the bookbinder went to the ner for some of his best skins; the tanner got his ns from the neighbouring butcher or farmer, and ned them with the materials he found in the ality. There was then no idea of chemicals or ificial colouring matters, and there was no reason y the skins should not last. Nowadays circum-ances were quite different. Very few of the ins tanned in England were produced in England, ey came from the Cape, Australia, and all rts of the world. They could not be sent as they re, they were salted or otherwise treated, except those which were dried in the sun, which was the least injurious method of preserving them. Then they were frequently stored a long time before they were shipped, and might become partially decom-posed even before the voyage, during which there was again the danger of injury from heating. When they arrived here they were sold by auction in bales, and the quality of the hides, even from the same place, was found to vary greatly; one bale might be perfectly sound and another perfectly rotten. It was therefore quite true that no one could absolutely guarantee the quality of skins, as they had not watched them from the beginning, but only in the later stages. All the manufacturer could do was to use his best judgment, and do all he could to keep the skins as sound as possible. With regard to different kinds of leather, you could not say that sheep-skin was bad, and morocco good; there was good and bad of both, and a good sheep-skin was better than a bad morocco. Aniline dyes, as a rule, were not injurious to leather, though some might be. As a general rule light leathers stood better than dark.

Mr. WALTER REID congratulated the author on the very complete and yet temperate manner in which he dealt with the subject; for anyone who loved books must have been often annoyed to find them in a state which would hardly bear handling. There were many in the Patent-office library in a worse condition than he had seen anywhere else. There was a set of the "Comptes Rendus" which he almost feared to touch; and yet side by side with them, were books bound in parchment which were quite perfect. Parch-ment was not a very convenient material for binding — they must have leather of some kind. One of the most hopeful subjects for inquiry was as to other methods of tannage, especially mineral tan-nage. If you found the books on the upper shelves of a library in a worse condition than those on the lower shelves, it did not follow that the difference was due to the heat; wherever gas was used you found the upper shelves worse than any other part. The watery vapour condensed on the books, which were at a lower temperature and absorbed the sulphurous acid. This by further oxidation became converted into sulphuric acid; it was found even in the paper of the books as well as in the binding. Sulphuric acid was sometimes used in the preparation of leather, apart from the dyeing, though he did not suppose any authority on the subject would recommend it; for the purpose of getting rid of the lime. He believed the best way to do this, was by means of a bath in which bran was fermented, producing lactic acid, which neutral-ized the lime. The modern method of tanning was quite different from the old. Formerly oak bark was used, but now if you ordered oak tanned leather, you got something tanned with oak extract, made from oak timber in some place where it was cheap. Oak bark could, of course, be got if insisted on; it

was largely a question of price. It was a question whether some substitute could not be found for leather in bookbinding, and he believed compounds of cellulose might be found which could be embossed and ornamented in the same way as leather, and which could have a guarantee for durability. It was not at all necessary that aniline dyes should be acid; there were some basic ones, which would have an advantage in case there were any traces of sulphuric acid, that they would not only indicate it, but neutralise it. He believed that the military scarlet was now produced by aniline dye, and no one would suggest that that was fugitive. In his experience the worst bindings were brown, which was another reason why all the mischief should not be attributed to the dye. He feared that in the present stage of knowledge it would be difficult to formulate any standard for the hall-marking of leather. Chrome leather was, he believed, the most durable; it would stand immersion in boiling water. One tanner might use a chrome tannage, and another a less durable vegetable matter; one might use a mineral dye which was stable, and another a vegetable dye, and how could you get a standard. The only thing you could do was to test the chemical purity of the materials used; with the constant advances that were being made, he did not think a fixed standard and hall-marking would be feasible.

Mr. COCKERELL, in reply, said he did not blame the aniline dyes themselves so much as the way in which they were used; one of the questions to be investigated was whether any of these dyes were permanent, and could be used without injury to the leather. He had not been able to find out what dye was used in the Niger skins, but it certainly was very permanent, and seemed to be the same as the original red morocco, originally called Algerian morocco. Many books still remained bound in this leather, and it was very unusual to find them broken at the joint. With regard to brown leather being the worst, he had known cases where tan-coloured bindings had been ordered, in order to prevent the leather being injured by dyes, and it had turned out that after tanning, being irregular in colour, they had been cleared with acid and then dyed back again to a tan colour. A skin as it came from the tan pit was not generally quite even in colour, and probably manufacturers did not care to send such skins. He had mentioned over-liming and puering as likely to cause damage, and he must say his chief authorities for attributing the damage in leather to sulphuric acid were Dr. Parker and Prof. Procter. It was of the utmost importance that this investigation when undertaken should be thorough; it would take a long time, but no superficial examination would be of any good. The fact that for many years the damage had been attributed almost entirely to the use of gas showed how dangerous it was to jump to a conclusion on insufficient evidence. He was glad to hear that aniline dyes were not necessarily fugitive, but those now used very often were, that was why some standard w[...] quired, because the bookbinder had not the ti[...] means of ascertaining these things himself. With [...] to the three firms whose names he had mention[...] understood that they only guaranteed the skins [...] free from injurious materials as far as they could [...] he hoped the committee would have the spec[...] they produced carefully tested. The great poi[...] that manufacturers were anxious to produce wh[...] required. Calf was no doubt inferior as a r[...] morocco, but the latter could not be relied on [...] the Patent-office, certain specifications were [...] in red and blue morocco, and they were [...] very bad state, especially the blue. Mr. Eps[...] remarks were extremely interesting, and the [...] of skins being damaged in transit before rea[...] England was very important. Mineral tannages [...] have to be inquired into: chrome leather appea[...] be just the thing required, but further tests [...] needed. He did not contend that gas was no[...] jurious, and of course ventilation should be att[...] to, but leather went to pieces in libraries [...] no gas was used. It seemed very lamentable t[...] the end of the 19th century they could not obt[...] good leather as that which was used in the [...] century. If manufacturers could not guarantee [...] product, they must make the best of it, but it se[...] rather humiliating. His knowledge of tanning [...] necessity second hand, but as far as he could asce[...] oak extract, if used properly, would give as [...] results as oak bark itself. What was wanted [...] reasonable security that the leather they used w[...] retain its toughness and flexibility as the old le[...] did. One great difficulty had been that the [...] ducer and consumer had not been sufficientl[...] touch with each other, and if the investigation o[...] committee tended to bring the tanner and b[...] binder closer together it would be a great advan[...]

The CHAIRMAN, in proposing a vote of thank[...] Mr. Cockerell, said the effect produced on his [...] by the paper and discussion was that the root o[...] evil lay in the ignorance of the public as to what [...] good, durable, and artistic, and what was not, an[...] would suggest that an exhibition should be arran[...] under the auspices of the Society of Arts, or the [...] and Crafts Society, showing specimens of both [...] binding and bad; what to aim at and what to av[...] When Dr. Parker read the directions for dealing [...] leather from the handbook, it struck him that if [...] author were a bookbinder, his advice might [...] accounted for, as the result of following it w[...] naturally be a large increase in the amount of bo[...] binding to be done, as the books would soon req[...] rebinding. When Mr. Panizzi became keeper of [...] printed books in the British Museum, in 1[...] he discarded calf and Russia bindings alm[...] entirely, and took to morocco, which seemed [...] show that by that time the former had b[...] recognised as unsatisfactory. There were, howe[...] some very durable specimens of calf binding; [...]

y the decline set in about the beginning of 19th century, which he feared was a period general decline in everything relating to the ianical part of the production of books. Mr. enport suggested that the beautiful red colour he Italian bindings of the 15th century was luced by cochineal,* but if cochineal was overed and imported from Mexico, it could ly have come into use as a dyeing material 1530.

addition to the specimens of bindings and ier illustrating the paper, a portrait of Colonel en-Powell, on specially-prepared pigskin, was bited, as a novel application of leather, by srs. John Muir and Sons, of Beith. The lines of portrait were produced by the agency of heat, a l blast of hot air being employed. The work is to be extremely permanent, and it is suggested the process is applicable to the decoration of ier for various purposes.

Miscellaneous.

ATIONAL PHYSICAL LABORATORY.

[r. R. T. Glazebrook, F.R.S., Director of the ional Physical Laboratory, Old Deer-park, Richd, Surrey, has issued a circular letter respecting newly-formed establishment.

1 the year 1898 a Treasury Committee, of which l Rayleigh was Chairman, recommended the blishment of a National Physical Laboratory for dardising and verifying instruments, for testmaterials, and for the determination of physical stants, by the extension of Kew Observatory.

t the request, and with the support of Her esty's Government, such a National Physical oratory has been established, and the Royal ety have appointed an Executive Committee to age it, and, among other duties, to control the k which has in the past been carried out by the v Observatory Committee at the Kew Observry. This work has been transferred by the Kew imittee to the Royal Society. The Executive imittee, of which the President of the Royal iety is Chairman, Lord Rayleigh Vice-Chairman, the Permanent Secretary of the Board of Trade official member, includes representatives of the 'al Society, the Kew Committee, the Institutes of l, Mechanical, and Electrical Engineers, the Iron Steel Institute, the Society of Chemical Industry, the Institute of Naval Architects.

t is the intention of the Committee to continue and extend the work of testing scientific instruments hitherto carried on at the Kew Observatory, and they believe that tbis work will be benefited in every way by the increased facilities for experimental investigation afforded by the resources of the laboratory. The Committee are glad to add that Dr. Chree, together with all the present members of the Observatory staff, have consented to transfer their services to the National Physical Laboratory, so that the continuity of the work will be fully maintained.

Certificates will bear the heading "National Physical Laboratory, Richmond, Surrey," and will be signed by the director. Instruments and other articles sent for testing should be addressed to the Director, National Physical Laboratory, Old Deer-park, Richmond, Surrey.

Cochineal was introduced into Europe from Mexico in , and Cortes, in 1523, received instructions from the iish Court to procure it in as large quantities as possible. as not, however, known in Italy in 1548, and was first in Holland by Cornelius van Drebbel, at Alkmaar, in . (See *Encyclopædia Britannica.*).

General Notes.

MINERAL STATISTICS, 1899.—An advance proof of the Tables relating to the output of coal and other minerals, and the number of persons employed at mines worked under the Coal and Metalliferous Mines Regulation Acts, during the year 1899, has been published by the Home-office. The total output of coal in the United Kingdom was 220,085,303 tons, as compared with 202,042,243 tons in 1898. The total of fireclay was 2,931,091 tons, as compared with 2,783,219 tons in 1898; ironstone, 7,775,868 tons, as compared with 7,901,046 tons in 1898; oil shale, 2,210,824 tons, as compared with 2,137,993 rons in 1898. The total number of persons employed in the mines and quarries was 729,009 (583,009 below ground, 139,770 above ground), as compared with 706,894 (567,124 below ground, 139.775 above ground) in 1898.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

APRIL 4.—"Cotton Supplies." By JOHN A. BANISTER.

APRIL 25.—"Industrial Resources of Portugal." By J. BATALHA REIS, Consul-General for Portugal in London.

FOREIGN AND COLONIAL SECTION.

At 4.30 o'clock:—

APRIL 2 (Monday).—"The Century in our Colonies." By the Right Hon. SIR CHARLES WENTWORTH DILKE, Bart., M.P. The Right Hon. LORD STRATHCONA AND MOUNT ROYAL, G.C.M.G., LL.D., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

APRIL 3.—"Process Engraving." By CARL HENTSCHEL. WILLIAM LUSON THOMAS will preside.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Foreign and Colonial Section.) Sir Charles W. Dilke, "The Century in our Colonies."

Royal Institution, Albemarle-street, W., 5 p.m. (General Monthly Meeting.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Dr. G. Sims Woodhead and Mr. W. J. Ware, "Disinfection of the Maidstone Water Service Mains."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. A. G. Salamon and Mr. E. N. Goldie, "The Manufacture of Caramel."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Papers on "Artisans Dwellings," by Messrs. Honeyman, Spalding, Wallis, and Fleming.

Camera Club, Charing-cross-road, W.C., 8¼ p.m. Mr. J. Groves, "Japan."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Cav. Jervis, "North Polar Thalassography."

TUESDAY, APRIL 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Carl Hentschel, "Process Engraving."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. E. Ray Lankester, "The Structure and Classification of Fishes." (Lecture XII.)

Central Chamber of Agriculture (at the HOUSE OF THE SOCIETY OF ARTS), 11 a.m.

Meteorological, 25, Great George-street, S.W. 3 p.m. (Commemoration Meeting.) Address by the President, Dr. C. Theodore Williams. 8½ p.m., Conversazione at Institute of Painters in Water Colours, Piccadilly, W.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Henry Deane, "Economical Railway Construction in New South Wales." 2. Mr. Robert Stirling, "The Tocopilla Railway."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. F. P. Cembrano, "Slides, Old and New."

Biblical Archæology, 37, Great Russell-street, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Mr. G. E. H. Barrett-Hamilton, "*Mus Sylvaticus* and its Allies." 2. Mr. Stanley S. Flower, "Notes on the Mammals of Siam and the Malay Peninsula." Dr. Einar Lönnberg, "Piece of Skin from Cueva Eberhardt, Patagonia."

WEDNESDAY, APRIL 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. J. A. Banister, "Cotton Supplies."

Geological, Burlington-house, W., 8 p.m.

Sanitary Institute, 74A, Margaret-street, W., 8 p.m. Mr. T. Blashill, "Housing of the Working Classes in London in the Future."

Naval Architects, in the Rooms of the Society of Arts, 12 noon. 1. Address by the Chairman, the Earl of Hopetoun. 2. Rear-Admiral C. C. P. Fitzgerald, "The Japanese Navy." 3. Mr. B. Martell, "A Short Account of some of the Changes which have been introduced into the Types, Sizes, and Construction of Ships, during the period of my Connection with Lloyds Register." 4. Captain G. Russo, "Experimental Work on the Rolling of Ships on Waves."

Archæological Association, 32, Sackville-street, W., 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Inst., 20, Hanover-square, W., 4 p.m.

THURSDAY, APRIL 5.. Royal, Burlington-house, W., 4½ p

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. Dr. I Scott, "*Sphenophyllum* and its Allies, an E Division of the Vascular Cryptogams."

Chemical, Burlington-house, W., 8 p.m. 1. G. S. Newth, "The Liquefaction of a Gas by ' cooling'—a Lecture Experiment." 2. Mr. Newth, "Note on Partially Miscible Aq Inorganic Solutions." 3. Mr. W. H. So "The Decomposition of Chlorates (II. Chlorate)." 4. Mr. A. W. Crossley, "The I action of Mesityl Oxide and Ethyl Sodiome malonate." 5. Messrs. J. T. Hewitt and W Aston, "The Bromination of Benzeneazophe

Society for the Encouragement of Fine Art Conduit-street, W., 8 p.m. Conversazione a Institute of Painters in Water Colours, Picca W.

Royal Institution, Albemarle-street, W., 3 Mr. H. J. Mackinder, "Equatorial East A and Mount Kenya." (Lecture III.)

Electrical Engineers, 25, Great George-street, S 8 p.m.

Mathematical, 22, Albemarle-street, W., 8 p m.

Camera Club, Charing-cross-road, W.C., 8¼ Dr. H. R. Mill, "Town Sites from a Geograp Point of View."

Naval Architects, in the Rooms of the Socie Arts, 12 o'clock. 1. Prof. J. H. Biles, "L Cargo Steamers." 2. Mr. A. B. Wortley, " Practical Results of some Innovations in Mo Shipbuilding." 3. Captain E. W. Hovga "The Strength of Elliptical Sections under F Pressure." 4. Mr. H. C. Vogt, "Yacht Meas ments, together with some Remarks on the Ac of Sails." 7 p.m. 1. Herr Otto Schlick, " Balancing of Steam-engines." 2. Mr. M. Sa son, "The Engines of the Corvette Jen Baquedané." 3. Prof. Lorenz, "The Unifor of Turning Moments of Marine Engines."

FRIDAY, APRIL 6...Naval Architects, in the Rooms of Society of Arts, 12 o'clock. 1. Prof. H. S. H Shaw, "The Pressure on an Inclined Plane, special reference to Balanced Rudders." 2. I G. H. Bryan, "The Action of Bilge Keels." Major Guiseppe Rota, "The Influence of Dept Water on the Resistance of Ships." 7 p.m. Signor Roberto Schanzer, "Mysterious Fract of Steel Shafts." 2. Mr. A. Scott-Youn "Corrosion and Failure of Propeller Shafts."

Royal Institution, Albemarle-street, W., 8 p Weekly Meeting, 9 p.m. Prof. Dewar, "S Hydrogen."

Civil Engineers, 25, Great George-street, S.W p.m. (Students' meeting.) Mr. H. E. Wimp "Experiments on Struts with and without Lat Loading."

Geologists' Association, University College, W 8 p.m. Mr. G. E. Dibley, "Zonal Features of Kentish Chalk-pits between London and the M way Valley."

Junior Engineers, Westminster Palace-ho S.W. 8 p.m. Mr. Eustace W. Porter, "A Co parison of Railway-bridge Structures of Moder Dimensions and of Methods of Determining tl Working-Loads."

Philological, University College, W.C., 8 p m.

Quekett Microscopical Club, 20, Hanover-squ W.C., 8 p.m.

SATURDAY, APRIL 7...Botanic, Inner Circle, Regent's-pa N.W., 3 p.m.

Royal Institution, Albemarle-street, W., 3 p Lord Rayleigh, "Polarized Light." (Lecture V

ournal of the Society of Arts,

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l communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

In place of Professor Fleming's Cantor Lec-res on "Electric Oscillations and Electric 'aves," which are unavoidably postponed in nsequence of the lecturer having been un-pectedly summoned to America, Professor VIAN B. LEWES will deliver a course of ree lectures on "The Incandescent Gas antle and its Use," on Mondays, May 7, 14, d 21.

OREIGN & COLONIAL SECTION.

Monday, April 2, 1900; The Right Hon. ORD STRATHCONA AND MOUNT ROYAL, C.M.G., LL.D., in the chair. The paper ad was "The Century in our Colonies," by e Right Hon. Sir CHARLES WENTWORTH ILKE, Bart., M.P.

The paper and report of the discussion will published in the next number of the urnal.

APPLIED ART SECTION.

Tuesday, April 3, 1900; WILLIAM LUSON HOMAS, Member of the Council of the ciety, in the chair. The paper read was on Process Engraving," by CARL HENTSCHEL.

The paper and report of the discussion will published in the number of the *Journal* for e 20th inst.

Proceedings of the Society.

INDIAN SECTION.

Thursday, March 29, 1900; SIR WILLIAM RERETON HUDSON, K.C.I.E., in the chair.

The paper read was—

THE CULTIVATION, MANUFACTURE, AND USES OF INDIGO.

By CHRISTOPHER RAWSON, F.I.C.

In the spring of 1876, the late Mr. George Jarmain, of Huddersfield, delivered a course of six lectures before this Society on "Wool Dyeing," and one of those lectures was devoted to Indigo. Since that period innumerable new colours have been discovered and introduced into the dye-house, but indigo may still be regarded as the most valuable and important of all colouring matters. On several occasions the indigo industry has been threatened with extinction, but in the great majority of cases the many substitutes which have been tried have been found wanting in some quality or other. Until recently all the colours used in place of indigo were "substitutes" in the strict sense of the term. They merely resembled indigo in being capable of producing a similar shade in dyeing: their composition was entirely different from that of the old natural dye. Within the last two or three years, however, an artificial product identically the same as the chief colouring principle of natural indigo has been on the market, and a considerable amount used in dyeing. How this will affect the cultivation and manufacture of indigo remains to be seen, but it would appear that everything depends on the cost of production in each case. I shall refer again to this subject later.

Indigo was used in India and Egypt long before the Christian era. Blue cloths found on Egyptian mummies 5,000 years old have been found to have been dyed with indigo. Pliny describes it under the name of *Indicum*, and mentions that it was brought to Europe from India, but appears to have had no knowledge whence it was derived, or of what it consisted. In many ancient writings the word *nila* is used both in connection with indigo and the plant from which it is derived. Prior to the discovery of the route to India by the Cape of Good Hope, indigo came to Europe by the Persian Gulf and Alexandria, and it was thought to be a product of Turkey. Very little indigo was used in Europe before the 16th century, and for many years afterwards the consumption was but small on account of the opposition of the woad cultivators, who induced the English, French, and German Governments to prohibit its use. The cultivators of woad contended that indigo was not only a fugitive dye, but that it was a corrosive and pernicious drug. In reality they feared that the importation of

indigo would ruin their trade in woad. In France the law was so severe that Henry IV. issued an edict condemning to death any one who used that "pernicious drug," which was called the "devil's food." The indigo plant thrives only in tropical climates, and by far the greatest amount of indigo is obtained from India, and more especially from Bengal, Oudh, and Madras. It is also manufactured in Java, Manila, China, Japan, Central America, Brazil, and certain parts of Africa.

The principal plants cultivated for the manufacture of this dye are the *Indigofera tinctoria*, *Indigofera anil*, *Indigofera disperma*, and *Indigofera argentea*. There are numerous other varieties of lesser importance. Indigo is also obtained from other plants besides the species of *Indigofera* but to a comparatively small extent. Among others may be mentioned the *Wrightia tinctoria* (cultivated to some extent in Madras), the *Strobilanthes flaccidifolius* (Assam), *Tephrosia toxicaria* (Bombay and Rajputana), the *Polygonum tinctorium* (China and Russia), *Lonchocarpus cyanesceus* (West Coast of Africa), and *Isatis tinctoria* (China, Afghanistan, &c.).

The *Isatis tinctoria* or woad plant was formerly largely cultivated in Europe, and was used almost exclusively up to the 16th century. It is still grown in Lincolnshire and on the Continent (South of France, Hungary, &c.), but is now never used alone for dyeing. It is used in the fermentation vats in dyeing woollen goods. These vats are in consequence called *woad-vats*. The woad assists the fermentation, and dyers further contend that it causes the indigo to penetrate more thoroughly into the interior of the fibre and prevents the vat getting out of order. An interesting account of the cultivation and manufacture of woad as carried out at the present day is given in *Nature* (November 12th, 1896) by Darwin and Meldola.

Cultivation.—As already mentioned, a great many plants are capable of yielding indigo, but the *Indigofera tinctoria* is the only one cultivated on a large scale in Bengal. Previous to the sowing of the seed the land undergoes a rather elaborate process of preparation. In October, soon after the manufacturing season, or *Mahai* is at an end, the land is dug by means of a large hoe. After hoeing, the land is ploughed. Usually about half-a-dozen bullock-drawn ploughs are driven close together from end to end of a field, whilst across the furrows thus made another half-dozen work at right angles. After ploughing, a pole, 5 to 8 feet in length, with one s flat, is drawn across the land. This implem drawn by two to four bullocks, is calle *hanga*. The flat side is on the ground driver stands at each end, and the *ha* is drawn backwards and forwards over land. This has the effect of breaking clods and smoothing the land. Sometime heavy roller is also used, but only where cl will not give way to the *hanga*. The l is then ploughed again three or four tin Finally the small clods of earth are fi pulverised by women and children, who short thick sticks for the purpose. They collect and remove all loose rubbish, such grass, weeds, and stumps of the previ season's crop. The seed is sown by d about the end of February or beginning March. It germinates in the course of fou five days, and by the middle of June, when manufacturing season usually commences, plant has obtained a height of from three five feet, and has a stem of about a quarte an inch in diameter.

The above is a description of the meth generally followed, but in several large conce steam cultivation has been introduced, and most modern agricultural machinery has b for some time in use.

The indigo crop is a very precarious o too much or too little rain is equally destr tive. After a few weeks' growth the pl may appear to be flourishing beautifully, w the tap root going deeper into the grou comes across a dry layer of soil; the pl then rapidly withers and dies, and the plan has to begin his sowings over again. R falling in February or March on seed recen sown, or on plants just through the soil, necessitate re-sowing. In bad seasons re-sowing may have to be done three or f times. Regarding accidents during the t of culture an interesting book on ind by Phipps, published about 1832, conta the following account:—

"The cultivation of indigo is exposed to m disastrous circumstances, the full operation of one of which may be fatal to all the sanguine ho of the industrious cultivator. It may truly be that his occupation is such as to unavoidably sub him to the greatest degree of mental anxiety; constantly to divide his mind between hope and The tender delicate stalk of the indigo plant, w young, is liable to numerous accidents. The w rain, and sun may all conspire to destroy it tempest or inundation, or bursting of the bu in the lower province, may sweep the whole

y. A too great or too little proportion of rain, ven a moderate quantity, but not even in a proper on, are alike injurious to its successful growth. n the earth sometimes denies its assistance; for, ie soil be too much worn, it languishes; producnothing but weak stalks, which perish almost as ı as they appear. The scorching of the sun is ther injury which it may sustain, of no inferior ree of malignity, especially during the first month ts growth. The cause of these scorchings arise ı the rays of the sun darting upon the rising plant ıediately after it has been refreshed by frequent vers. These rays coming suddenly on the soil ed by the great quantity of water it had im-d communicate to it such a degree of heat, ch it again imparts to the plant, that this last ds like a faded flower, and withers and cones by the quick and alternate operation of an ss of cold and heat. To these accidents may ıdded the depredations of animals; and all the sfaction you can obtain of their owners is to nd them till they are claimed, or send them to nearest *thannah*. Again, destruction is made by ll bugs that are ever on the alert to destroy the t while springing out of the ground, and particu- at the time it is in two or four leaves. Caterrs bury themselves in the earth to avoid the ent heat of the sun in the day time and issue ı in the cool of the evening to begin their work epredation, which they continue during the whole he night; after which they convert themselves chrysalises, and become butterflies and inhabit- of the air. White ants are also very destructive he root of the plant, and no seed ought to be ı where they are seen."

s an illustration of the precarious nature of indigo crop we may take the results of last r. A month or so before the time of cut-, the crop was looking exceedingly well, there was every indication of a good son. However, rain fell heavily and almost inuously during the greater part of July part of August, and there was very little shine. The consequence was that the it gave little produce, and the season ed out to be one of the worst on record. he preceding year (1898) Behar was visited reat floods in September, and much of the nd cuttings (*Khoonties*) were swept away.

he leaf of the indigo plant is of a yellowish-n colour, and shows no indication whatever s containing anything productive of a blue uring matter.

he following table shows the mean results welve samples as analysed (air-dried), and calculated on the green plant containing it does on an average) 75 per cent. of er. The different samples showed a conrable variation in their composition. The mineral matter varied in the air-dried leaf from 8·40 per cent. to 14·40 per cent. One sample contained 5·48 per cent. of nitrogen, whilst another showed only 3·75 per cent. As shown by the "carbolic acid method," about four-fifths of the total nitrogen present in leaves exist in the form of albuminoid compounds.

ANALYSIS OF INDIGO PLANT (*Indigofera tinctoria*).

——	Air-dried.		Green Plant.	
	Leaves.	Stems.	Leaves.	Stems
Water	10·42	9·75	75·00	75·00
Nitrogenous matter*	29·37	5·94	8·19	1·65
Oil, &c., soluble in ether	3·85	1·05	1·07	·29
Woody fibre	11·07	47·50	3·09	13·16
Carbo-hydrates and other organic matter	33·29	31·01	9·30	8·60
Mineral matter (ash)†	12·00	4·75	3·35	1·30
	100·00	100·00	100·00	100·00
Matter soluble in water—				
Organic	25·05	9·05	6·99	2·51
Mineral	7·55	2·65	2·11	·73
*Containing nitrogen	4·64	·94	1·293	·260
†Mineral matter containing-				
Silica	·628	·051	·175	·013
Phosphoric acid	·916	·344	·255	·095
Sulphuric acid	·296	·074	·084	·021
Carbonic acid, &c.	2·885	1·163	·806	·323
Chlorine	·050	·074	·014	·021
Oxide of iron and alumina	·086	·020	·024	·006
Manganese oxide	·040	·020	·011	·008
Lime	3·591	1·275	1·002	·353
Magnesia	1·298	·164	·362	·045
Potash	2·210	1·460	·616	·404

The proportion of leaf and stem constituting the indigo plant varies greatly. The mean result of twenty determinations gave, in round numbers, 40 per cent. of leaf and 60 per cent. of stem. On this basis, the composition of the whole green plant will be as follows:—

COMPOSITION OF WHOLE GREEN PLANT.

Water	75·00
Nitrogenous matters	4·27
Oil, &c., soluble in ether	·60
Woody fibre	9·14
Carbo-hydrates and other organic matter	8·87
Mineral matter (ash)	2·12
	100·00
Matter soluble in water—	
Organic	4·30
Mineral	1·28
Containing nitrogen	·673
Mineral matter containing—	
Silica	·078
Phosphoric acid	·159
Sulphuric acid	·046
Carbonic acid, &c.	·519
Chlorine	·018

Oxide of iron and alumina	·013
Manganese oxide	·009
Lime	·615
Magnesia	·172
Potash	·491

There is a very great variation in the amount of plant yielded by an acre of land. A fair average crop may be taken at 50 to 60 cwts. per acre. Taking the lower figure a crop of indigo plant removes 118 lbs. of mineral matter from an acre of land. Of this amount 9 lbs. are phosphoric acid and 27½ potash. The plant from an acre of land also contains 37·7 lbs. of nitrogen; but as indigo is a *leguminous* plant, a portion of this nitrogen is probably derived from the atmosphere. With a few trifling exceptions the only manure hitherto used for the cultivation of the indigo plant is the plant itself after the colouring principles have been extracted. The refuse plant, which is called "seet," is only applied to land near factories, so that much of the land has been growing indigo for years without the application of any fertilisers. The refuse plant is a valuable manure. It contains all that is necessary for the growth of a new crop. The air-dried "seet" contains a greater percentage of nitrogen than the original plant (air-dried), and the ash contains more phosphoric acid, though rather less potash, than the ash of the original plant.

The soils of Behar contain an abundance of potash and a fair proportion of phosphoric acid. The majority of the soils examined contain but a small proportion of nitrogen. This is rather remarkable, in consideration of the large percentage of nitrogen present in the plant, but, as already stated, a portion of this element is no doubt derived from the atmosphere. Dr. Voelcker, in his report on "Indian Agriculture," 1893, and Dr. Leather, in the *Agricultural Ledger*, 1898, call attention to the small percentage of nitrogen to be found in Indian soils generally.

The following table contains the results of analyses of four samples of indigo soils from Behar.

Manufacture.—The manufacture of indigo in Behar is almost entirely carried out under the direction of Europeans. The manufacturing season usually commences about the middle of June, but it may be a fortnight earlier or a fortnight later. Soon after cutting, the plant throws forth fresh leaf, and after two or three months a second crop is obtained. The first and principal crop is called the *Morhan* crop and the second the *Khoonties*. The

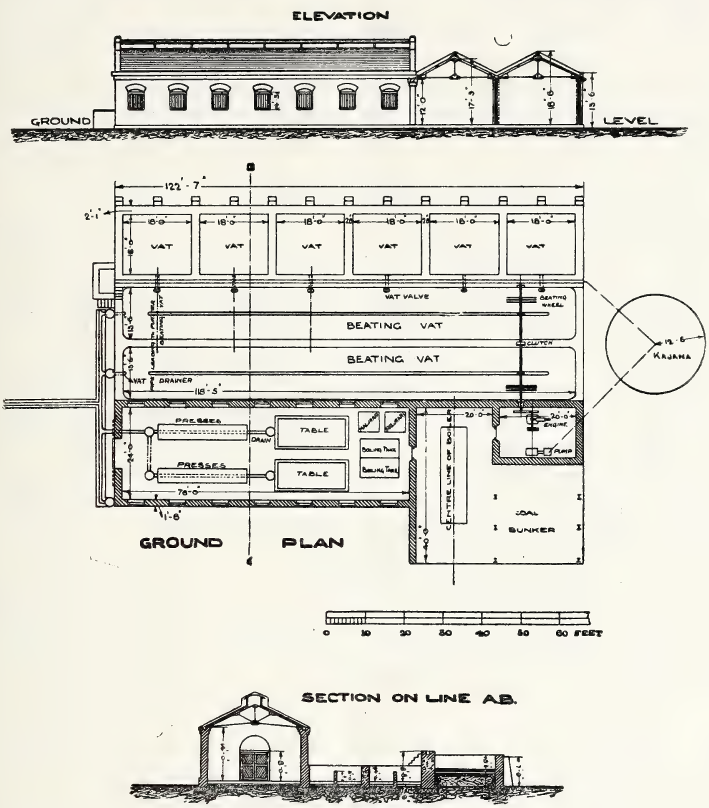
COMPOSITION OF BENGAL INDIGO SOILS.

In 100 parts of Dry Soil.	Champarun District.		Tirhoo Distric	
	Light sandy.	Heavy clay.	A.	]
Organic matter and combined water*	1·40	1·95	2·60	
Sand and insoluble silicates	53·85	87·55	87·90	8
Phosphoric acid (O_2O_5)	·17	·13	·10	
Sulphuric acid (SO_3)	·05	·04	·03	
Carbonic acid, &c. (by diff.)	17·37	1·06	·67	
Oxide of iron	2·25	4·90	2·60	
Alumina	3·75	4·20	3·35	
Lime	20·60	·42	1·05	
Magnesia	·22	·45	1·30	
Potash	·34	·30	·40	
	100·00	100·00	100·00	10
*Containing nitrogen	·065	·055	·080	·0
Equal to ammonia	·078	·066	·097	·0

manufacturing seasons are spoken of as t *Morhan Mahai*, and the *Khoontie Mah* respectively. In some cases a week or a fo night elapses between the two seasons; others there is no break. The plant is c early in the morning, often before daybrea and taken to the factory in carts, each drav by two bullocks. The work on an indi concern is usually divided among a number factories—from two to ten or twelve accordi to the size of the concern. Each factory dea with plant grown within a radius of four or fi miles. At a moderate-sized factory son hundreds of cart-loads of plant are treat every day throughout the manufacturi season. The scene presented in the morni round the steeping vats, with the long lines heavily laden bullock carts slowly wending the way from various points towards the factory, a very busy and imposing one.

The accompanying diagram (the origin was kindly furnished by Messrs. A. Butl and Co., Mozufferpore) shows the general pla of a small indigo factory. It contains s steeping vats and two beating vats. Th former are arranged on a higher level than th latter. Each steeping vat has a capacity of little over a thousand cubic feet. The actu dimensions are 18 feet by 16 feet by 3 feet inches in depth, the depth being measure to the cross beams and not to the top of th vat. Each range of beating vats runs th whole length of the six steeping vats, and ha a width of 13 feet 6 inches; a wall 3 feet hig runs down the centre of the beating vat, but space is left at each end so as to allow of free circulation of the liquid when the wheel i

in motion. The beating wheel consists of shaft armed with three sets of spokes. ese spokes (six in number in each set) are nished at the extremities with blades which, revolving, churn up the liquid and cause a ntinual circulation. In some cases the eping vat is divided into three parts and the eel works in the central division. The vats built of brickwork faced with Portland nent. They are usually open to the air, ugh in some cases the steeping vats are vered. There are great variations in the angement of vats in different factories. In ne cases there are as many as eight steep- vats to one beating vat. The steeping s are frequently arranged on each side two or three ranges of beating vats, ilst in other cases the steeping vats are anged in long rows with the beating s alongside at a lower level. The arrange- nt shown in the diagram, however, is most modern. Formerly the steeping vats re much larger than at present, having a acity of about 2,000 cubic feet, and each vat l a corresponding beating vat. The liquid was "beaten" by hand instead of by the wheel, and each vat required ten to fifteen coolies armed with beating sticks. In Madras and the North-West Provinces, this method is still generally followed, and some factories in Behar have also a few hand-beating vats. In addition to the vats, the requisite plant of an indigo factory includes a steam-boiler and engine, pumps, boiling-tanks, draining-tables, presses, drying-house, and various workshops. The drying-house and workshops are not shown in the plan. On a higher level than the steeping vats a large water-tank, or *kajana*, is situated. This is sometimes made of iron, but more usually it is constructed of brickwork and Portland cement like the vats. The water is pumped into the *kajana* from the neighbouring river, stream, or lake, and from it the steeping vats are filled.



PLAN OF INDIGO FACTORY.

Loading the Vats and Steeping.—In the first place the vats are thoroughly cleaned; this is carefully done every day. A number of coolies enter the vat and scrub every part well, using a plentiful supply of water. The plant is then closely stacked in the vat, in a more or

less upright position, so as to allow the entangled air to escape more freely, and the liquid, after steeping, to drain away more completely.

The amount of green plant put into a vat of 1,000 cubic feet capacity varies from 11,000 to 15,000 lbs. When filled, a number of pieces of bamboo are placed across the tops, and the whole kept in position by three or four stout pieces of timber fixed by iron pins running through racks attached to the sides of the vat. Water is now run into the vat until it reaches within a few inches of the beams. If filled completely, the liquid would subsequently overflow, as the plant undergoes a considerable expansion during the steeping process. A great pressure is thus exerted, and occasionally a beam is broken or the vat gives way. An abundant supply of good water is indispensable; every pound requires from 300 to 500 gallons, and upon its quality largely depends the successful working of the operations. The chief sources of supply are river water, lake water, and rain water. The rivers of Behar generally flow from Nepal in the north, in a south-easterly direction, and empty themselves into the Ganges. The largest is the Gundak, on the west. Rain water is either collected in large tanks dug in the ground, or in natural depressions forming *chowrs*. Much of the soil in Behar is calcareous, and it frequently happens that the rain water in these tanks and *chowrs* contains as much mineral matter as the neighbouring river. Lake water varies greatly in composition according to rainfall. In times of drought, lake water often contains much organic matter in solution and suspension; such water is always considered to give bad results in indigo manufacture, both as regards produce and quality. The length of time required for extracting the colour-yielding principles varies from nine to fourteen hours, according to the temperature and other climatic conditions. Ten to eleven hours may be considered a fair average period. The temperature of the water in June, July, and part of August is usually from 88° to 95° Fahr., whereas in September it falls to about 80°, when a longer steeping is necessary. Indigo plant is not easily wetted by water, and for an hour or two no action takes place. As pointed out by Bridges-Lee, the leaves of the plant are covered by an immense number of small hairs, which no doubt are the chief cause of their water-repelling power, but the property is also due to the vitality of the plant itself. When the water comes into intimate contact w the leaf the colouring principle is rea extracted. It is very soluble in water. A two or three hours the liquid rises in the bubbles of air are liberated, and the surf becomes covered with a thick froth. Carb dioxide is evolved in large quantities, and the later stages either marsh gas or hydrog or a mixture of the two, is freely given If a light be applied to the surface of the towards the end of the steeping operatio blue flame, extending for several yards, n frequently be obtained. The vat has certai the appearance of being in an active state fermentation. After a time the liquid subsid and this is the chief indication to the overse or the manager, that the plant is sufficien steeped. The valve is now opened, and liquid run into the beating vat. In ma cases a large wooden plug is used instead a valve.

After the solution has run off, the plant of course, saturated with the same liqu and even if all the colouring principle is tracted from the leaf, it would appear th a second steeping or at least a washing wo be advantageous. The leaf, which prior steeping was of a yellowish colour, is n bluish-green, and appears to be much m capable of yielding indigo than the origi plant. It has been found in practice, ho ever, that a second steeping is unprofitab Whilst the liquid is draining off from t plant, it would seem that the colour-givi principle, which is left in solution on t leaves and twigs, is rapidily decomposed a destroyed. A small portion forms indigo bl but this is left on the plant in an insolu state, and is, therefore, not extracted by second steeping. After the water has r off, the temperature of the plant rises rapidl

The extracted plant or "seet" is tak out to be subsequently applied as manure the land, and the vats prepared for anoth steeping.

Beating.—The liquid running from t steeping into the beating vat varies in col from a bright orange to an olive green, a possesses a peculiar fluorescence. Wh sufficiently steeped the liquid which runs at first is of an orange colour, but it so changes to a yellow and finally to an oli colour. When all the vats are discharg the wheel is set in motion, at first slow and gradually increasing to a maximu Under normal conditions from two to thr hours are required to complete the operati

beating; although in some cases the length time may be reduced to one or one and a lf hours. A considerable amount of froth is med especially if the plant has been over eped. In such cases there is frequently a th of two or three feet in depth on the surface the liquid. This is kept down as much as ssible by coolies, who walk through the uid with a cloth stretched across the vat and ng the froth under the beating wheel where ich of it is broken up. When nearing com-tion the froth, which at first was bluish, comes white and gradually disappears. In meantime the liquid changes through rious shades of green to dark indigo blue. order to ascertain when the beating is com-te the *mal mistri* takes up some of the uid and pours it on to a white plate. If the in or "fecula" readily settles, leaving a ar fluid, the beating is considered accom-shed and the wheel is stopped. Sometimes ittle lime is added to the contents of the te. A better plan is to saturate a piece of er paper with the solution and subject it to fumes of ammonia. If the slightest blue ouration is developed it is an indication t the beating is not complete. In place of beating wheel various other devices for dising the liquid have been tried but not ierally adopted. Decidedly superior results ve been obtained by forcing a current of air ough the liquid, and this method will be put o force on a large scale at several factories ing the coming season.

After beating, the indigo "fecula" is owed to settle, which usually takes two or ee hours, when the supernatant liquid eet water" is run off, either by means of surface drainer, or by removing a series of oden plugs arranged down the side of the . The bottom of the vat is inclined towards corner, where the precipitated indigo or *l* is collected, passed through one or strainers, whence it flows to a well, or *l jhari*, from which it is elevated, ally by means of a steam-injector, to a ge rectangular iron tank. The *mal* is ined again twice on its way from the well he boiling tank. Every precaution is taken keep the indigo clean, and free from bits of gs and dirt.

Boiling and Filtering.—The liquid con-ing indigo in suspension (to the extent of ut 0·5 per cent.), when lifted by the steam-ctor has usually a temperature of 140°-° Fahr. It is not always actually boiled, is heated (now usually by steam, but in some cases by direct fire, or by steam and direct fire combined), up to temperature varying from 190° to 212° Fahr. In some cases the steam is shut off as soon as the liquid begins to boil; in others, the boiling is continued for a quarter or half an hour. There is a three-fold object in boiling the *mal;* 1st, it prevents putrefaction, which rapidly takes place in such a hot, moist climate as that of India during the manufacturing season, and would result in much loss of colour; 2nd, it dissolves some of the brown matters which have precipitated with the indigo fecula and thus produces a finer quality; 3rd, it causes the indigo particles to settle more readily, so that the refuse liquor may be run off without delay. In some factories the supernatant liquid is run off from the boiler, fresh water added, and the whole boiled up a second time. After boiling, the indigo is allowed to settle, the clean liquid is run off as far as possible, and then the hot concentrated *mal* is run through strainers on to a large filter known as the "table" or "dripping vat." There are two tables shown in the plan, each 18 feet long and 7 feet wide. They are constructed of narrow parallel laths fixed close together on a stout wooden frame, with sides about 18 inches high, sloping outwards. The "table," which stands in a shallow trough made of cement, is covered with a sheet of strong cloth specially made for the purpose. At first the liquid comes through blue, and it is pumped back on to the cloth until it is perfectly clear. It is usually of a sherry colour. Much of the liquid passes through the filter cloth, but a considerable portion is also removed by carefully letting down a corner of the cloth after the precipitate has settled into a more or less thick paste. The paste is then scraped down towards one end of the filter and the cloth folded over. After allowing an hour or two for the liquid to drain still further, the pulpy mass, containing in this condition from 8 to 12 per cent. of indigotin, is ready for pressing.

Pressing and Cutting.—The press consists of a rectangular strongly-made box, the frame-work having on all sides numerous perforations. Each factory has a number of presses in operation. They stand upon heavy beams of timber or strong iron girders. The box is well fitted with two thicknesses of strong, closely-woven, cloth, and is arranged under a pair of powerful screws, which can be turned with long levers. The cloth is wetted and the paste from the "table" introduced into the box to a depth of

9 inches to 13 inches, according to its consistency; the amount being regulated so as to obtain a pressed slab of 3 inches to $3\frac{1}{4}$ inches in thickness. The screws are turned very slowly at intervals extending over several hours. Unless great care is taken the cloths burst and indigo is lost. When no more liquid is seen to be oozing from the block the pressure is gently and evenly released. The slab, which now contains about 70 per cent. of water, is put on to a frame and cut by means of a brass wire into cubes of about 3 inches to $3\frac{1}{4}$ inches in size. Each cube is stamped with the mark of the factory and the number of the day's boiling and taken to the drying-house.

Drying.—The drying-house is a lofty well-ventilated building, containing a number of shelves, about a foot apart, of light bamboo or wire netting. The cubes are placed on these shelves, about half-an-inch apart, and left for a period of two or three months to dry. This drying takes place very slowly, as at this period of the year the humidity is high. Strong currents of air are not permissible, otherwise the cakes crack, and the value of the indigo in the Calcutta market is thereby much depreciated. There are usually a number—more or less—of cakes broken, but the greatest care is taken to keep them whole. During the drying, a considerable amount of ammonia is evolved, and the cakes become covered with a thick growth of fungus. When dry, the cakes are brushed and packed into cases or chests, which are usually made of well-seasoned mango wood.

Practically the whole of the colouring matter is derived from the leaves. Even the finest stems yield but traces of colour. The average amount of indigo produced on a manufacturing scale from 100 lbs. of green plant is about four ounces. An acre of land, with an average crop, yields approximately about 15 lbs. of good Bengal indigo. The variations in produce are, however, very wide, due to various causes. Much depends upon the relative amount of stems and leaves constituting the plant.

The above is a brief description of the process of manufacture now generally followed in Behar. Innumerable patents have been taken out in India for improved methods, and in many cases extraordinary results have been said to have been obtained, but sooner or later the "patent" process has been discarded and the manufacturing operation has fallen back into the ordinary routine as already described. Improvement has been claimed at various times for the addition, either to the steeping beating vat, of all kinds of "chemical many of an oxidising character, some red ing; substances added with a view of augme ing fermentation and others for the purpose arresting or preventing it. Much differe of opinion exists as to whether fermentation necessary for the production of indigo blue whether the fermentation which occurs merely a consequence of the steeping proc Inasmuch as indigo in large quantities may obtained from the plant by infusion in water for a few minutes, it would appear t fermentation was unnecessary for the forn tion of the colouring matter. It was form considered that indigo blue existed re formed in the plant, and at a later period t it was present in the form of reduced indig indigo white. Many years ago Dr. Schunck in his classical researches on "Formation of Indigo Blue," proved these views to be incorrect. He found leaves of certain indigo-yielding plants, *Isatis tinctoria* and the *Polygonum tinctorium*, to contain a peculiar compo which he named *Indican*. It would be of place on this occasion to enter theoretical considerations regarding the mation of indigo blue, but in connec with this matter I should like to call attention to some beautiful specimens of *Polygonum tinctorium*, treated many y ago by Dr. Schunck, to whom I am inde for being able to show them to-day. plants were grown near Manchester in summer of 1875. When immersed in bo alcohol, the chlorophyll and indican wer moved, and the leaves left of a yellowish- colour, thus proving the absence of r formed indigo in the plant, indigo bein soluble, or nearly so, in alcohol. When vitality of the fresh leaf had been part destroyed by being punctured or froze treated with an acid or cold spirits of and then placed in boiling alcohol, those tions which had been affected became and the other portions were grey or colou The specimens, therefore, further show tha leaves of this plant contain a body (solu alcohol) which, under certain condition more or less quickly converted into an inso blue colouring matter—indigo. Apart theoretical considerations the specimen exceedingly interesting from a practical s point. It is evident that the *Polygonum tinctorium* is capable of yielding a conside amount of colouring matter, and as it flou

a temperate climate, it might be profitably tivated during the cold weather in India. I 1 find no account as to the amount of colour plant yields, but hope shortly to make ex-iments myself in this direction. The plant s long been known and employed as a source indigo by the Chinese. It was introduced o Europe in the 18th century, and about the ar 1830 to 1840 formed the subject of numer-s investigations by eminent French chemists d botanists. Some hopes were entertained it the plant might be cultivated profitably in ance, but numerous trials led to no practical ult.

Constituents of Indigo.—Indigotin is by the most important constituent of natural ligo. Its proportion varies greatly, from 5 to per cent. Good Bengal indigo may be said contain on an average from 60 to 66 per nt. Madras indigo, on the whole, is of in-ior quality. Much contains on an average out 30 per cent., but the variations are much eater than in the case of Bengal indigo. me qualities contain upwards of 50 per cent. oadly speaking, the indigo made in the rth-West Provinces (Oudh, &c.) is of a ality intermediate between that of Bengal d Madras. Java indigo contains, as a rule, largest percentage of indigotin; but the neral opinion of woollen dyers in England is it it does not give such good results as a gh-class Bengal of a corresponding quality. digo also contains another colouring matter considerable tinctorial value—viz., indirubin indigo-red. Until comparatively recently s constituent was rarely present beyond the tent of 2 per cent., but at the present time ligo frequently contains as much as 10 per nt. and upwards.

In addition to indigotin and indirubin, natural ligo contains a variety of other substances ich are usually regarded as impurities, ough in some cases the organic matters un-ubtably have an appreciable effect in dye-g. They comprise indigo gluten and various own substances, and amount in all to about to 30 per cent. Natural indigo always ntains more or less mineral matter. This is rtly derived from the leaves of the plant, and rtly from suspended matter (clay and sand) esent in the water used for steeping. The nount of mineral matter found in natural ligo varies greatly, from 2 or 3 per cent. to per cent., and even more. Good Bengal ligo usually contains from 3 to 6 per cent.

Indigotin, $C_{16}H_{10}N_2O_2$, may be prepared in a re state in a variety of ways. A simple method consists in gently heating a little powdered commercial indigo in a platinum dish or tray, covered with another dish of the same size. The indigotin sublimes or condenses on the surface of the upper dish in beautiful needles of a purple colour. It may also be obtained by boiling finely powdered indigo with aniline, filtering while still hot, and allowing the liquid to cool, when indigotin crystallises out. After washing with alcohol, the product is pure indigotin. Pure indigotin crystallises in beautiful dark blue or purple needles, which exhibit a coppery reflex. The powder, which is of a deep blue colour, assumes a bright red, bronzy appearance when burnished. The vapour possesses a beautiful red-violet colour, resembling that of iodine. In the open air, although the greater portion of the indigotin sublimes, it is partially decomposed, leaving a mass of porous carbon. In an inert gas it may be volatilised without decomposition. When submitted to dry distillation, that is, heated in a closed vessel either alone or with an alkali, indigotin is decomposed, the chief product being aniline.

Indigotin is a neutral body, and is insoluble in water, ether, dilute acids, and alkalies. It is slightly soluble in boiling alcohol with a blue colour, but is again deposited on cooling. Amylic alcohol, carbolic acid, chloroform, and carbon bisulphide also dissolve small quantities when hot, but the best solvents for indigotin are glacial acetic acid, nitro-benzene, and aniline. Boiling paraffin dissolves indigotin with a magenta colour. Concentrated sulphuric acid completely dissolves indigotin, but since its composition is changed sulphuric acid cannot be considered a solvent for indigotin as such. Glacial acetic acid containing a few drops of sulphuric acid dissolves indigotin with a deep blue colour, and on dilution with water it is reprecipitated unaltered. By the action of oxidising agents, such as dilute nitric acid, chromic acid, &c., indigotin is converted into isatin or indigotic acid. If nitric acid is used hot it forms nitro-salicylic acid or picric acid according to the strength of the acid. At the same time other products such as carbonic acid and oxalic acid are formed. By the action of certain bodies termed "reducing agents" (compounds capable of giving up nascent hydrogen or assimulating oxygen) indigotin is converted into a colourless compound known as *indigo white* or *reduced indigo*. This body is soluble in alkaline liquids—such as lime, potash, or soda. It is in this form that indigo is used for dyeing.

The material to be dyed is immersed in a vat containing reduced indigo; this on exposure to the air is oxidised to indigotin, which is thus fixed in the insoluble form on the fibre.

There are numerous substances which have the power in alkaline solution of reducing indigo-blue to indigo-white—*e.g.*, sodium amalgam, zinc, tin, aluminium, magnesium, &c., ferrous hydrate, hypo-sulphurous and hypo-phosphorous acids, sulphide of arsenic, &c., and certain organic ferments. Reduced indigo is a greyish white amorphous powder, insoluble in water and dilute acids, but soluble in alcohol and ether and in alkaline solutions; the powder on exposure to air oxidises to blue indigotin. The change rapidly takes place in the presence of water. An alkaline solution of reduced indigo has a brownish-yellow colour: an excess of reducing agent gives a clear bright yellow solution. On exposure to the air it becomes at first green, then blue, and is covered with a bronzy scum, which consists of minute crystals of indigotin. If an oxidising agent, such as potassium bichromate, be added to the solution the blue colour of indigotin is at once developed.

Indigotin Sulphonic Acid.—It has already been stated that indigotin dissolves in concentrated sulphuric acid, thereby undergoing a change in its composition. According to the conditions, either mono or disulphonic acid is formed.

Indigotin Monosulphonic Acid. — Also known as sulpho-purpuric acid and indigo-purpuric acid, is obtained by mixing one part of indigotin with four parts of concentrated sulphuric acid, and allowing the mixture to stand not more than half an hour when it is diluted with water. A beautiful purple precipitate is formed, which is only sparingly soluble in water. The sodium salt is used in dyeing, under the name of indigo-purple, red extract of indigo and red indigo carmine.

Indigotin Disulphonic Acid.—Also known as sulphindigotic acid, is obtained by treating indigotin with a large proportion of sulphuric acid, and allowing it to act for a longer time, or by heating the mixture or both combined. One part of indigotin treated with 10 or 12 of concentrated acid, at a temperature of 90° C., is converted into sulphindigotic acid in about half an hour. At the ordinary temperature it is necessary to allow the mixture to stand for 10 or 12 hours; and if the acid be not of the full strength (1·845 sp. gr.), several days are required. On diluting with water the sulphonic acid remains in solution, being soluble in about 60 parts of water. If any sulphopurpuric ac is present, it is precipitated in the form of purple powder,

Sulphindigotic acid, or indigo sulphate as is often termed, is decolourised by reducir agents in a similar manner to indigotin itse The colourless solution becomes blue again exposure to air. By the action of oxidisi agents, such as potassium bichromate a potassium permanganate, it is converted in sulphisatic acid. Both these series of r actions are utilised for the estimation of i digotin in commercial indigo. Sulphindigot acid is decomposed by strong solutions caustic alkalies, forming at first a green a ultimately an orange coloured solution. We solutions and alkaline carbonates form sulp indigotates, which are soluble in water, b very sparingly soluble in strong saline sol tions. The potassium salt dissolves in abo 150 parts of water, and the sodium salt somewhat more soluble. The lead salt is i soluble, and the barium salt only very sparing soluble.

Artificial Indigotin.—After many years labour, artificial indigo was introduced into t market under the name of "indigo pure," July, 1897, by the Badische Anilin und So Fabrik. Indigotin had previously been pr duced synthetically in a variety of ways, b the cost of production was far above that of t natural product. Baeyer's name will alwa remain inseparably connected with the sy thesis of indigo. In 1870, Baeyer and Emme ling succeeded in producing indigotin fro isatin, but the synthesis was not complete un 1878, when the former chemist obtained isat from indoxyl, and, in conjunction with Suid prepared in its turn indoxyl from orthoamid phenlyacetic acid. In 1880 Baeyer obtain indigotin in various ways from cinnamic aci One method may be briefly summarised follows:—

(*a*). Formation of ortho-nitro-cinnamic aci

(*b*). Treatment with bromine whereby orth nitro-dibrom-hydrocinnamic acid is produce

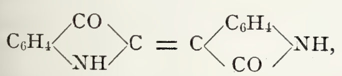
(*c*). By action of caustic alkali ortho-nitr phenylpropiolic acid is obtained.

(*d*). Reduction with glucose or xanthat when indigotin is formed.

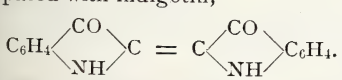
In 1882, Baeyer and Drewsen obtained ind gotin from ortho-nitro-benzaldehyde by trea ing this compound with acetone or acet aldehyde in the presence of caustic alkali. this reaction ortho-nitro-phenyl-lactone formed as an intermediate product. In 18 Kalle and Co. introduced their "indigo salt,

ıich consists of the above-named body in mbination with sodium bisulphite. It is ıdily soluble in water, and yields at once on ɜ addition of caustic soda, indigotin. In 1890 ɜumann's synthesis of indigo from phenyl-ycocol was published. When heated with ustic alkalies to a temperature of 250° C., enyl-glycocol is converted into pseudo-loxyl, which on oxidation yields indigotin. ıis process along with several others for e production of indigotin and intermediate mpounds is in the hands of the Badische ıilin und Soda Fabrik. The exact method ıployed by this firm for the manufacture of ligotin, or "indigo pure," is not known, but is said to be obtained from naphthalene. hen naphthalene is oxidised at 200° C. by lphuric acid in the presence of mercury, thalic acid is formed. By various steps thalimide, anthranilic acid, phenyl-glycin-ho-carboxylic acid, indoxyl-carboxylic acid, d, finally, indigotin are produced. Synthetic, artificial indigotin, possesses the same emical and dyeing properties as indigotin ɜpared from natural indigo. The two in-gotins may be considered to be identical. archlewski and Radcliffe* have studied the etyl oxidation products obtained from in-gotin from Kalle's salt, indigo "rein" of the ıdische Anilin und Soda Fabrik, and in-gotin from natural indigo. In all cases ɜntically the same results were obtained.

Indirubin, or indigo red, possesses the me empirical formula as indigotin, viz., $H_{10}N_2O_2$ Schunck and Marchlewski† have own that it is the indogenide of isatin, and s the constitution :—



compared with indigotin,



It has been previously stated that when lican is submitted to fermentation, or treated h dilute acids, it splits up into indigotin d sugar. This indican is very susceptible of eration, and its modifications yield, accord-g to existing conditions, either indirubin or liretin and indihumin, the latter two bodies ming indigo-brown. Schunck found that en indican was mixed with caustic soda, d allowed to stand some days, the solution lded indirubin but no indigotin. Indican, thus modified by the action of caustic soda, was named by Schunck *indicanin*.

Indirubin is said to be formed in larger quantities than usual when indican is decomposed by oxalic or tartaric acid. It may be obtained from commercial indigo by extraction with alcohol or ether, indigotin being insoluble. The indigo should in the first case be boiled with dilute hydrochloric acid, and washed with water. A hot concentrated solution of indirubin in alcohol deposits the indirubin, on cooling, in the form of microscopic bundles of dark purple-coloured needles. Indirubin sublimes at a lower temperature than indigotin, and condenses in the form of beautiful crimson needles. It is unaffected by weak acids and alkalies, but, like indigotin, is reduced to a colourless compound, soluble in alkalies, by the action of substances yielding nascent hydrogen. Wool or cotton immersed in such a solution and then exposed to the air, becomes dyed a fast purple colour. Indirubin is soluble in alcohol, ether, acetone, and glacial acetic acid. It dissolves in concentrated sulphuric acid, forming a deep crimson solution which produces no precipitate on solution with water. This solution is oxidised but slowly by potassium permanganate or bichromate. If solutions of indigotin and indirubin sulphonic acids be mixed together and titrated in the cold with potassium permanganate, the whole of the blue compound is decomposed (decolourised) before the red is affected. On slowly continuing the addition of potassium permanganate, the colour of the solution passes from a crimson to a bright scarlet, and then through various shades of orange to a bright yellow. Indirubin itself is unaffected when boiled with a mixture of potassium bichromate and sulphuric acid, whereas indigotin is decomposed.

Indirubin dyes wool and cotton crimson shades which are exceedingly fast to light. The sulphonic acid of indirubin is far faster than the corresponding indigotin compound.

Artificial Indirubin. — Like indigotin, indirubin can also be made synthetically, and has been put on the market to a limited extent by the Badische Anilin und Soda Fabrik. Baeyer obtained it by the action of indoxyl on isatin, and it is also produced along with indigotin by the reduction of isatin chloride. The constitution of synthetic indirubin was first established by Baeyer, and the formula he proposed has since been slightly altered by Schunck and Marchlewski. These chemists

* "Jour. Soc. Chem. Industry," 1898, p. 433.

† "Ber. d. Deuschen Chem. Ges.," 1895, p. 539.

have shown* natural and artificial indirubin to be identical. Later, Marchlewski and Radcliffe† have found synthetic and natural indirubin to behave in exactly the same manner under similar conditions. They found that indirubin was only slightly converted into indigotin in the presence of *alkaline* reducing agents; whereas complete conversion took place when treated with acid reducing agents. In face of the convertibility of indirubin into its blue isomer and on account of the small quantities of indirubin in natural indigo, they consider the importance frequently ascribed to indirubin in dyeing to be over-estimated. On the other hand, however, indirubin when present in an appreciable quantity in indigo has been found by actual practice to be of much value, particularly in wool dyeing.

Principally for the sake of economy, but also for other reasons, a red colouring matter, such as cudbear, camwood, &c., is frequently used in indigo dyeing, and indirubin is eminently suited for this purpose. It is true that until comparatively recently natural indigo rarely contained more than 1 to 2 per cent. of indirubin, but, as previously stated, much indigo now contains as much as 10 per cent. and upwards.

Indigo gluten may be removed from natural indigo, along with some of the mineral matter, by treatment with dilute acid. It is a yellowish-brown amorphous glue-like substance, possessing similiar properties to ordinary vegetable gluten. In cotton dyeing, it acts advantageously in making the colour faster to washing.

Indigo Brown. — The brown substances present in indigo are named by Schunck *indiretin* and *indihumin*. When a solution of indican is heated for some time and then treated with an acid it yields neither indigotin nor indirubin, but a dark brown precipitate consisting of these two bodies, which are invariably present to a greater or less extent in commercial indigo. The brown matter dissolves in caustic soda, and a portion of it is precipitated on neutralising the liquid with an acid. It dissolves in concentrated sulphuric acid with a deep dark brown colour, but is entirely precipitated on dilution with water. Schunck‡ describes the formation of five brown compounds derived from indigo blue. Under certain conditions one or more of these compounds may be formed during the process of manufacturing indigo.

* "Berl. Ber.," 1895, p. 539.

† "Jour. Soc. Chem. Industry," 1898, p. 434.

‡ "Memoir of the Lit. and Phil. Soc. of Manchester," 864-5.

Application of Indigo.—Indigo is a su stantive dye, that is, it does not require t assistance of another body or mordant to fi upon the fibre. In addition to the dyeing a printing of blues, indigo is used to a very gr extent as a bottom for compound shades; su shades (browns, olives, blacks, &c.), wh contain indigo are said to be *woaded*. In m cases the cloth or other material is dyed w indigo first and then filled up (mordanted necessary) with the other colouring matte In any case the indigo requires a special v Unlike most other dyes indigo is insoluble water, dilute acids and alkalies, and, as p viously stated, is applied to the textile fib in the form of indigo-white, or "redu indigo," which is soluble in alkalies. M of the substances already mentioned as be capable of transforming indigo - blue i indigo-white, are utilised on the large sc for the dyeing of indigo. For the dyeing wool the vats are usually heated to a tempe ture of about 140° Fahr. Cotton and ot vegetable fibres are usually dyed cold.

The following are the most important ind vats:—

Woad vat	Used wool dyein
Soda or German vat	
Hyposulphite or "Hydrosulphite" vat	
Hyposulphite or "Hydrosulphite" vat	Used cotto dyein
Copperas vat	
Zinc vat	

Dyeing of Wool.—In England the woad and the "hydrosulphite" vat are most larg employed. The former, which is the m important, is used principally for the dyein heavy cloth, and the latter chiefly for loose w slubbing, yarn, and lighter fabrics. Since Jarmain gave the series of lectures on w dyeing already referred to there have b very few changes in the methods of dye indigo.

Woad Vat.—Fermentation vats, of which wood vat is a type, require a great amoun skill and practical experience to be wor satisfactorily. Indigo dyeing is a specia and the men in charge of the vats n have previously served a long apprent ship to the craft. Unless the greatest car taken in conducting the fermentation m indigo is destroyed. The substances use the preparation of a woad vat are, bes woad and indigo, bran or sharps, madder lime. In fermenting, the starch of the bra converted into grape sugar which in passes into lactic acid, and then into but

d. During the last transformation, hydro-
ı and carbonic acid are formed. The
lrogen in the nascent state combines with
: indigotin and forms indigo-white.

t is important that the indigo should be in exceedingly fine state of division, otherwise : reducing action cannot take place, and : particles remain at the bottom of the vat so much inert matter. The indigo is put o a mill and ground for several days with ter, until a perfectly smooth paste free from y gritty particles is obtained.

The vats used in Yorkshire are either circu- or square, and have a capacity of 2,000 to oo gallons. The round vats are generally de of cast iron and are enclosed in brick rk so arranged as to leave a space for : admission of steam by which the vats : heated. Rectangular wooden vessels are ated by means of a coil of copper steam es arranged inside the vat.

In setting a woad vat so many different ys are adopted by different dyers that no ıct general directions can be given. How- r, the following description will give an idea the operation:—For a vat of 2,700 gallons pacity from 5 to 10 cwts. of crushed woad are roduced and the vat nearly filled with water. e whole is heated to about 145° Fahr., red two or three times, and left overnight. e stirring is now done mechanically, by ans of a screw fixed near the bottom of : vat, and worked by a movable perpendi- ar shaft. The second day, the requisite ount of indigo in fine paste, equal to 20 40 lbs. dry indigo, 15 lbs. madder, 30 lbs. bran or sharps, and 30 to 40 lbs. slaked e are added; the temperature is kept near ° Fahr., and the whole stirred two or three ıes during the day with the addition of 2 4 lbs. of lime each time. On the third rning if the fermentation has proceeded isfactorily, the vat will have the following pearances: The liquid will have a greenish yellowish-green colour, and on gently stir- g it blue streaks will appear with a coppery ım or "flurry." The sediment will be ınd to be in an active state of fermenta- n, and will possess a somewhat sour, but reeable odour. If a piece of wool be im- rsed in the vat and then exposed to the it will be dyed blue. If the fermentation ceeds too rapidly it can be checked by : addition of lime. On the other hand, if ggish it can be accelerated by addition of ın. As a rule a new vat is ready for eing in the course of three to five days. Before dyeing, the cloth must be thoroughly well scoured, and the soap removed by washing in warm water. The temperature of the vat is maintained at about 135° Fahr., and after giving time for insoluble matters to subside a net (trammel net) or latticed frame is lowered to a depth of about a yard so as to prevent the goods coming in contact with the sediment. The ends of the cloth are stitched together in the form of an endless band, and worked under the surface of the liquor by means of a "hawking" machine. This simply consists of a framework supporting a pair of squeezing rollers which can be lowered under the surface of the liquid. The goods are kept moving in the vat for various periods of time according to the shade required and according to the quality of the cloth. The dye penetrates thick heavy cloth but slowly, and when dark shades are wanted on some classes of goods the pieces are run for six or eight hours in the vat. They are removed and the colour is developed by exposure to the air. In this condition the goods are said to be "grounded," and it is arranged that the shade shall be rather lighter than that ultimately required. They are then passed into a weaker vat and worked until the desired shade is obtained. Lighter shades are dyed direct in one vat. As the goods come out of the indigo vat the colour is a yellowish green, but on exposure to air it quickly changes to a blue-green, and finally to the well-known shade of indigo blue. After dyeing, the goods have to be well washed in water and cleansed with soap and Fuller's earth in order to remove the indigo which loosely adheres to the outside of the fibres. This operation is of great importance; if imperfectly cleaned, the goods have the objectionable property of "rubbing," which counteracts in a great measure the admirable qualities possessed by indigo. If the pieces, however, had not been thoroughly cleansed before dyeing, or if the vat had been out of condition, no amount of fulling would overcome the liability of the goods to rub. Before going into the indigo vat, piece goods are frequently dyed a light shade of red with barwood, cudbear, or alizarin red. This "bottoming" with a red colour is necessary with cloth made from shoddy, in order to counteract the grey or brown shade of the material. The application of the red colour also prepares the cloth for the reception of the indigo, and, moreover, which is a matter of some importance, it makes the dye faster to rubbing. It must be borne in

mind, however, that in some cases a deep red bottom is put on the cloth for the sake of cheapness. It is possible to dye a dark navy blue with a large amount of red and a relatively small proportion of indigo. Loose wool and slubbing require a greater amount of indigo to produce a given shade than piece goods; each individual fibre being more completely dyed in the interior.

At the end of a day's working, about 7 lbs. to 20 lbs. of indigo, with the requisite amount of bran and lime, are added, and the vat well stirred, the temperature being maintained at about 140° Fahr. The vat is then covered, and the following morning will be again ready for use.

The Soda or German Vat is used extensively on the Continent, but rarely in this country. It is a fermentation vat, and is prepared in a similar manner to the woad vat. Although dyers vary the quantities greatly, as an example a vat may be prepared with the following ingredients:—For a vat of 2,000 gallons—5 to 10 lbs. of indigo, 50 lbs. soda crystals, 20 lbs. treacle, 12 lbs. madder, 60 lbs. bran, and 2 lbs. lime, this is not so well adapted for dark shades as the woad vat. The shades obtained, however, are somewhat brighter, and it is well suited for the dyeing of light blues.

The Hydrosulphite Vat.—In this vat indigo-blue is reduced to indigo-white by hyposulphurous or "hydrosulphurous" acid. The reduced indigo is usually prepared in separate vessels, and added to the vat as required. It is sent into the market in casks ready for use, the solution containing about 2 per cent. of indigotin. This solution may be prepared in the following manner:—Take 20 lbs. of indigo (50 per cent.), ground to an impalpable paste or powder, and boil with 20 gallons of water, add 25 lbs. of slaked lime in the form of cream. In the meantime, 70 to 80 lbs. of a solution of sodium bisulphite (1·25 sp. gr.) are mixed with 8 lbs. of zinc dust in a covered vessel, and kept cool by immersion in a larger vessel containing cold water. After half an hour or so the smell of sulphurous acid will have disappeared, when the mixture is poured into the vessel containing the indigo and lime. The mixture is heated for about an hour, made up to 500 lbs., and run off into casks. The solution will have a deep yellow colour, and on exposure to air, the surface becomes covered with a peculiar rich deep bronzy scum.

In starting a new vat of the dimensions already given, the water is run in and hea to about 140° to 150° Fahr., 50 to 60 lbs. bi phite of soda previously mixed with 5 lbs zinc dust, as already described, are add followed by 6 lbs. of slaked lime made int cream. The required amount of reduced ind liquor is then added, and after well stirr and allowing a quarter to half an hour impurities to subside, the dyeing operati may be at once commenced. Should the become oxidised, a little bisulphite of s previously mixed with one-tenth of its wei of zinc is added until the yellow colour restored. From time to time it may be a necessary to add a little lime.

The experiences of woollen dyers with "hydrosulphite" vat have been very vari It is certainly much more easily managed th a woad vat, and is not so liable to get out order. A much greater amount of work can done, since it is not necessary to wait fo huge sediment to subside, as in the woad va The goods dyed are usually cleaner th those dyed in wood vats. There is much l indigo mechanically attached to the outs of the fibres, consequently there is not much loss in washing and milling. Hea cloth dyers state, however, that the ind does not penetrate into the interior of cloth, and that more red colour is requi to give a certain shade. Perhaps greatest drawback to its general use is fact that the wool is liable to be more or l attacked; acquiring a harsh handle, a appearing thinner and poorer in quality. T is due to an excess of hyposulphite, as well to the presence of caustic soda in the vat; the action by careful management may reduced to a minimum.

Dyeing with Indigo Extract.—Referen has already been made to the action of co centrated sulphuric acid upon indigo, where it is converted into a compound soluble water. According to the subsequent tre ment which the solution receives, the produ are known as *acid or sour extract*, *neutr or sweet extract*, *refined extract*, *ind carmine*, *soluble indigo*, &c. Extract indigo is not applicable to cotton, and is us only for wool and silk. Formerly, mu greater quantities were used than now, as has been replaced in many cases by vario kinds of coal-tar colours. The more a varieties are employed for dyeing wool, wooll and worsted goods. Neutral extract is employ for silk, and particularly for dyeing the wors of mixed or union goods. It is also used

[. . .]nting woollen material and worsted yarn [f]or tapestry carpets, &c. Indigo extract is [us]ually dyed in a bath containing sulphuric [aci]d and sodium sulphate. If the extract is [ver]y acid, no further addition is necessary, [alth]ough, within certain limits, the more acid [the] bath is, the better is it exhausted. Sodium [sul]phate is employed in order to obtain more [reg]ular dyeing, the colour working on the wool [and] silk more slowly. In place of sulphuric acid, [alu]m and tartar are frequently employed.

[T]he shades produced with indigo extract are [mu]ch brighter than those produced with *vat [in]digo*, but, unfortunately, they are not fast. [By] conversion into its sulphonic acid deriva[tiv]e, the properties of indigo are entirely [cha]nged. Washing with soap and weak alka[lin]e solution more or less readily removes the [col]ouring matter from the fibre, and on expo[sur]e to light, the shade in a short time (varying [of] course, according to its depth and the con[diti]ons under which it is exposed) fades.

[C]otton Dyeing.—In the East, cotton is still [lar]gely dyed in fermentation vats; raisins, [dat]es, and honey being used in place of treacle, [wo]ad, and bran. In Europe, cotton is now [dye]d in so-called chemical vats, such as the "[h]ydrosulphite" vat already described. In [cot]ton dyeing, the vat is used cold, otherwise [the] preparation of it is the same as that for [woo]l.

[C]opperas or Ferrous Sulphate Vat.—This [vat], which constitutes, perhaps, the oldest [met]hod of indigo dyeing, is made up with [co]pperas, lime, and indigo. The lime decom[pos]es the ferrous sulphate, forming calcium [sul]phate and ferrous hydrate, and the latter, [hav]ing a great tendency to absorb oxygen and [pas]s into ferric hydrate, decomposes water, [libe]rating hydrogen. The hydrogen is not [giv]en off as gas, but immediately combines [wit]h the indigotin to form white indigo, which [dis]solves in the excess of lime present. The [amo]unts of indigo, lime, and copperas, vary [acc]ording to the work to be done, and the [ord]er in which the ingredients are added varies [wit]h different dyers. The most usual custom [is t]o put the indigo and copperas into the vat [firs]t and add the milk of lime gradually.

[T]he following figures give a general idea of [the] proportions of ingredients used :—

[W]ater..................	1,000 galls.
[I]ndigo..................	30 lbs.
[C]opperas (ferrous sulphate)	80 lbs.
[S]laked lime	60 to 100 lbs.

[T]he ferrous sulphate should be free from copper sulphate, ferric sulphate, and aluminium sulphate. Copper sulphate is injurious on account of its oxidising action, and the other sulphates are simply so much waste material. Ferric sulphate is indicated by the rusty appearance of the copperas.

The liquor, before dyeing, should be clear and of a brownish-amber colour. Before entering the goods the flurry is removed by means of an iron scoop called a *skimmer*. The sediment in a copperas vat may contain a considerable amount of indigo in combination with ferrous oxide, in the form of a bulky green precipitate.

The *zinc vat* is used to a considerable extent both in England and on the Continent. It is a simple vat, and possesses one or two advantages over the copperas vat. It contains but little sediment, and the constituents form no insoluble compound with indigo. It is made up with indigo, zinc dust, and slaked lime, which may be used in the following proportions :—

Water	1,000 galls.
Indigo	30 lbs.
Zinc	25 lbs.
Slaked lime	25 lbs. to 30 lbs.

The mixture is well stirred during a period of 18 to 20 hours, and then allowed to subside. Iron borings or filing are added by some dyers to this vat.

The zinc in the presence of lime decomposes water, forming zinc oxide. The liberated hydrogen then unites with indigotin to form indigo white.

Unless care is taken the vat is liable to be muddy and frothy, due to the liberation of hydrogen, but this only takes place when there is an excess of zinc.

Fastness of the dye: position of Indigo.—Indigo has been so long associated with the term "fast colour," that it would appear almost superfluous to speak of its admirable qualities as a dye. It has been known for many centuries and has withstood every test which has been applied to, or which can be required of textile fabrics.

Indigo is exceedingly fast to light, air, alkalies, acids, milling, stoving, and all the processes through which cloth passes during its manufacture and subsequent operations. Sea water and sunlight which destroy so many colouring matters, have very little action upon this dye. I have recently exposed cloth dyed with indigo to brilliant sunshine in India for a period of ninety days. The colour retained its

richness and bloom perfectly, and in depth of shade was but very slightly affected. At the same time a piece of cloth dyed with logwood lost its colour entirely, and alizarin blue faded to a dull reddish slate shade.

Another great advantage of indigo is that cloth so dyed is stronger and fuller than the same material dyed with other colouring matters. Indigo is dyed at a comparatively low temperature, whereas almost all the substitutes are applied at the boil, and the cloth is previously boiled for some time with mordants such as bichromate of potash. It is a well-known fact that indigo feeds the cloth, whilst the mordant dyes have a decided tendency to impoverish the wool fibre, and impart to the material a harsh feel.

Indigo has only one drawback to being a perfect dye. It has a tendency to smear or rub off, but with care this property may be reduced to a minimum. The rubbing of indigo has received the attention of dyers and chemists for many years, but it has not yet been entirely overcome. There is still scope for decided improvements in this direction, and a successful investigator would be well repaid for his time and trouble.

The excellent qualities of indigo have been recognised on every hand and for many years coal-tar colour manufacturers have been trying their utmost to find substitutes for it. Innumerable blue colouring matters have been introduced, but among this host of substitutes, for richness, beauty and fastness, indigo to-day has no rival. In connection with this statement it would be only just to point out that I do not look upon artificial indigo tin as an indigo *substitute*. So far as our knowledge of the matter extends, all chemists who have studied the question agree that synthetic indigo is identically the same compound as the indigotin of natural indigo. Natural indigo, as already mentioned, contains other substances than indigotin. These bodies undoubtedly have some value in dyeing, but, in my opinion, no good can be done to the indigo industry by contending that they are indispensable to the production of a good fast and permanent blue dye. They assist in the dyeing process and a smaller amount of indigotin is required to produce a given shade than if indigotin only were present. The most important constituent in natural indigo, other than indigotin, is indirubin. For wool dyeing particularly, this colouring matter is of considerable value, and not only enhances the richness of the shade, but economises indigo. Statements have frequently been made that indirubin wa essential to good indigo dyeing inasmuch a by its means the colour was fixed upon th fibre. In my opinion, however, there is n justification for such statements. Providin the synthetic dye can be produced in sufficie quantity, the whole question of artificial *versu* natural indigo will resolve itself into one of cos At the present time the price is decidedly favour of the natural product, and there seem every probability that, by improvements to b introduced into the manufacturing operation a much greater yield of colouring matter w shortly be obtained from the plant, thereb cheapening the cost of production. Moreover, firmly believe, that careful attention to cultiva tion, selection of land, selection of seed, an application of suitable fertilisers, will resu not only in a greater yield of plant per acr but that a plant will be obtained containin a higher percentage of the colour - yieldin principle.

The past two seasons have been disastro ones to planters, but providing the weather not abnormally unfavourable there now seem every prospect of the indigo industry flouris ing for many years to come.

As previously mentioned, the indigo cr is greatly dependent upon the weather; hen we find great variations in the exports fro year to year. Notwithstanding the seve competition of coal-tar colours during the pa twenty years the exports of indigo from Ind have not materially changed. It is true th for many styles of dyeing, coal-tar colou have largely replaced indigo, but the amou thus replaced appears to have been compe sated by the opening up of new channels by the general increase in the trade of t textile industries throughout the world. Pr bably the consumption of indigo has be most affected by the introduction of ac colours, which have to such a great exte superseded extract of indigo.

Although indigo has been cultivated India for many centuries, the amount in ported from the whole of Asia into Gre Britain, in 1782, was only 25,500 lb. In t same year the States of America and t West Indies furnished 225,500 lb., the to imports amounting to 495,000 lb. From th year the imports steadily increased; in 17 they amounted to 4,368,000 lb., of whi Bengal alone furnished 2,955,000 lb. 1815, the indigo exported from Beng amounted to 7,650,000 lb. or rather more th 3,500 tons.

The following Table shows the amount of digo exported from India from 1877 to ;98:—

MOUNT OF INDIGO (IN CWTS.) EXPORTED FROM INDIA FROM 1877 TO 1900.

Years ending larch 31.	Exported from Bengal.	Exported from Madras, Bombay, and Sindh.	Total.
377	69,379	30,987	100,366
378	99,402	21,203	120,605
379	74,747	30,304	105,051
380	47,928	52,995	100,923
381	88,111	28,759	116,870
382	91,898	58,465	150,363
383	99,715	41,326	141,041
384	110,015	58,575	168,590
385	106,009	48,560	154,629
386	76,109	56,386	132,495
387	87,941	50,455	138,396
388	87,335	52,309	139,644
389	86,701	55,746	142,447
390	91,835	65,281	157,116
391	69,819	48,606	118,425
392	98,075	27,252	125,327
393	61,637	65,066	126,703
394	76,398	55,001	131,399
395	106,830	59,478	166,308
396	111,714	75,623	187,337
397	109,001	60,543	169,543
398	73,475	—	—
399	82,666	—	—
)00	56,666	—	—

According to the Board of Trade returns, ie value of the indigo imported into Great ritain far exceeds that of all the aniline and izarin colours of every description.

Northern Behar, which comprises the district Tirhoot, Chumparun, and Chuprah, furnishes bout two-fifths of the total amount of indigo oduced in India. From 250,000 to 300,000 res of land are devoted to the cultivation of ie plant, and some million-and-a-half of ople are employed in the industry. In the ree districts there are more than a hundred ncerns comprising about three hundred ctories.

Statistics regarding the cultivation of indigo e very conflicting. This is due in a great easure to the terms "bigha" and "maund" ing very elastic in their significance. Dr. Vatt, in his "Pamphlet on Indigo," calls tention to this want of uniformity and diffi- ilty in arriving at any definite conclusion garding the yield of indigo and the area of land under cultivation. The *bigha* of land in Lower Bengal is one-third of an acre; in some parts of Tirhoot it is six-sevenths; in the greater part of the North-West Provinces it is five-eighths; and in many other provinces it is three-quarters of an acre; in Champarum, near to the Nepaul frontier, it is as much as two acres. The Bengal factory maund is 74·66 lbs.; the Madras maund 24·68 lbs.; the Bombay 28 lbs., whilst the Imperial maund is 82·28 lbs.

According to Phipps, the area of land under indigo cultivation in Bengal in 1829 was 600,000 acres. Dr. Watt calculated that in 1884-5 the cultivation for the whole of India was approximately 1,300,000 acres.

In 1899 the area of land under indigo cultivation in Bengal was estimated at 452,700 acres. At the commencement of the season this was calculated to return 130,000 maunds of indigo, but on account of the heavy rains the amount was reduced to 85,000 maunds.

Due largely to the scare produced by the recent introduction of artificial indigotin by the Badische Anilin und Soda Fabrik, the price of indigo has been greatly reduced, though there has again been a rise on account of the small crop of last year. This reduction will no doubt result in a much greater consumption of the dye. From a scientific point of view, the production of artificial indigotin is undoubtedly a grand achievement, but if it can be produced in large quantities at such a price as to render indigo planting altogether unprofitable, it can only be regarded by Englishmen as a national calamity. In connection with this matter I should like to quote a passage from Dr. Schunck's presidential address, in 1897, to the Society of Chemical Industry. At that time "Indigo rein" of the Badische Co. was not on the market.

"That it has been found impossible successfully to replace natural indigo by an artificial product may, from a moral and æsthetic point of view, be regarded as not altogether a misfortune. To replace a manufacture depending on an interesting organic process, carried on under healthy conditions, mostly in the open air; a manufacture which brings wealth into poor districts, and introduces system and order, and civilisation among uncultured people, by one carried on perchance in some dingy, sepulchral cave in a chemical works, by some fixed and unalterable process, might from a higher point of view be a doubtful advantage."

In addition to hundreds of thousands of natives, the industry in Behar alone gives employment to about 700 Europeans. The

planters have formed a volunteer cavalry corps, and this has enabled the Government to do away with the cavalry regiment previously stationed at Behar. Our chairman (Sir Wm. Hudson) commanded the regiment for fifteen years, and its high state of excellency, which is admitted on all hands, is largely due to his untiring efforts and power of organisation.

With a view of fostering the industry in India the English Government has wisely decided that all blue cloth supplied to the Royal Army and Navy Clothing Departments shall be dyed with *natural* indigo. Even in Germany, where the coal tar colour industry reigns supreme, the order has gone forth that military cloth (except such as is used for undress uniforms) shall in future be again dyed with indigo instead of alizarin which has been tried for some years past. Although in this case *natural* indigo is not specified, it should be cheering news to the indigo planter that in the country which produces so much alizarin—this colouring matter, the chief competitor of indigo—should be practically admitted to be inferior to the old blue dye.

Detection of Indigo on the fibre.—A blue colour on cloth similar to indigo may be produced in so many different ways, that it is desirable that one should be able by a few simple tests to identify it. Before the introduction of coal tar colour, this was an exceedingly easy matter as there were only two other blues then known—viz., logwood and Prussian blue. The application of a drop of nitric acid to the cloth at once distinguished between indigo, logwood and Prussian blue. Now the "nitric acid test" can only be taken as a guide.

Cloth dyed with pure indigo should fulfil the following conditions:—

Pure concentrated Sulphuric acid.—Place a small piece of the material (about half-square inch) in a porcelain basin and just cover with pure sulphuric acid. The liquid at first becomes greenish yellow or olive, then passes through various shades of green to a deep blue. After half an hour or so dilute with water. The solution is of a *bright blue* colour if pure indigo. If alizarin the solution becomes violet; if logwood and indigo are present together the solution on dilution becomes green or greenish blue according to the amount of logwood present.

Sulphuric Acid and Water.—Take a piece of cloth about 1 inch square and boil 5 to 10 minutes with dilute sulphuric acid (1 part of acid to 10 parts of water). A porcelain basin, wide test tube, or small beaker may be used for boiling. From ½ to 1 oz. of dilute acid is a convenient quantity. If pure indigo the acid solution remains colourless.

Dilute Solution of Soda.—Boil another piece of cloth for about 10 minutes with a solution of common washing soda (1 part of soda dissolved in 50 parts of water). The liquid remains colourless if the material is dyed with pure indigo.

Nitric Acid Test.—Put two or three drops of strong nitric acid on a piece of cloth. If pure indigo a bright yellow spot with a green rim is quickly developed.

When making a trial, tests should be made at the same time with cloth known to be dyed with pure indigo.

In the presence of other colouring matter the detection of indigo is not quite so easy. Many may be removed by boiling the cloth successively with hydrochloric acid, soda, and alcohol. Some dyes such as alizarin blue are only partially removed, and in their presence other means of testing for indigo must be resorted to. If cloth containing indigo is boiled with aniline or nitrobenzol the colour is removed, and may be identified by subjecting it to tests already described. Another very delicate test for indigo is to heat the sample with sodium "hydrosulphite." A solution of reduced indigo is obtained which on exposure to air turns blue.

Cotton fabrics dyed with indigo give off violet vapours when gently heated.

Extract of Indigo is distinguished from vat indigo by the colour being removed on boiling with a dilute solution of soda. On the addition of an acid to the solution the colour is intensified and a piece of wool or silk may be dyed blue in it. Nitric acid gives a similar spot with extract of indigo as with pure vat indigo.

The paper was illustrated by a number of lantern slides and by various experiments. A great many samples of cloth and yarn dyed with indigo and with other colouring matters were exhibited.

DISCUSSION.

The CHAIRMAN, in inviting discussion, after thanking Mr. Rawson for his very clever and interesting paper, said he had made the most of what to many present must be rather a dry subject, and had treated it most fully from the objective side, and he would merely add that the capital invested in the industry in the province of Behar was three years ago estimated at o er 4 m'llicns sterling. He should

ke, however, very briefly to call attention to another de—to what Spencer calls the "faint aggregate" -in other words, to the feelings of the planters with gard to their position, past and present. First nongst those feelings was one of gratitude (not, erhaps, an invariable characteristic of human affairs) -gratitude to Sir Steuart Bayley for his action 23 ears ago, when, with the co-operation of the Bengal overnment, he initiated a system which had had the appiest, and most far-reaching effects on the relaons of the planters with their native fellowubjects of all classes. In mentally reviewing e incidents of his long and distinguished career, ir Steuart Bayley might always recall this action d its results with just satisfaction. As the *Times* id, "It placed indigo planting in Behar on a basis erhaps not the most economical to the employer, ut which aimed at securing the welfare of the opulation employed." As an administrator, this ould naturally be his paramount object, and it in no ay prejudiced that just and necessary action, even the eyes of the planters, that they now found emselves in conflict with a European system of roduction of substitutes for indigo on the most eenly competitive basis. They further felt that they n legitimately ask Government for protection against e effects on them as producers of deceptions ractised on the public by the use of the words Indigo-blue dyed" to describe all kinds of inrior substitutes. They did not complain of fair ompetition — but this filching of the name of eir product seemed to be just the reverse—and, fact, contrary to common honesty. And that the interests of the public and the Government f India, as well as of the producer it ought to be opped. It might be possible to stop it under the resent law, but if it were not, legislation might irly be asked for to accomplish it.

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., id the paper they had just heard was really much more ll and interesting than it would appear to the audience ho had only heard a portion of it. The author had ot only traced the history of indigo as a dye, but d given a history of the plant from the preparation the soil, right through the processes of manufacre, until it had done its work in the dyers' vats, and roduced the colours which they all so much admired. e had also shown what indigo had to look forward in the way of chemical rivalry, and had also held ut hopes of a longer life for the industry, and of medies to be found for threatened competition in etter production and a larger yield. It was a paper f which any society might be proud, and he was very eased it had been read before the Indian Section of e Society of Arts. He might also say how glad he as that his old friend, Sir William Hudson, had onsented to preside on that occasion. He had rerred to the small part which he (Sir Steuart Bayley) ok some 23 years ago in connection with the digo industry of Behar, but it was really to Sir William Hudson that the planters of to-day owed very much of the success of their industry so far. The matter need not be gone into in detail, but the action of a reforming Lieutenant-Governor did no doubt arouse in the minds of the planters of that time considerable doubts and fears as to what would happen to them; and it was the action of Sir William Hudson in organising, as a reforming body, the Planters' Association, and by getting them to take action from inside instead of allowing it to be taken from outside, that he had saved the situation. He need not refer to the enormous help he had been to the whole community as well as to the Government with regard to the Behar Light Horse; it was to him mainly that its efficiency was due, and he might also mention Major Edwards, formerly the Adjutant who now commanded the Imperial Light Horse at Ladysmith. He need not explain why he took such an interest in this subject. He served most of his time in Behar, and amongst the older planters he could number many intimate friends. His interest, however, was not so much from the chemical or commercial side, or even from the side of old friendship, as it was from the administrative side. It was as an old official, a collector, a judge, and afterwards a commissioner in those districts, that he learned to appreciate the value of the English gentlemen planters in North Behar. It was not an English colony exactly, but it was the nearest thing to it in India. There were some 700 Europeans employed, and a capital which the Chairman estimated at £4,000,000, with an annual expenditure of £300,000. There were 300,000 acres under indigo, and an enormous population who were dependent upon it for their living, and that in a district where the pressure of population was greater than in any other part of agricultural India. When he was there the population in the southern parts of the planting districts was over 800 to the square mile; what it was now he dare not estimate—probably 850 or over. You could not ride ten miles in any part of those districts without coming across a planter's bungalow, such as had been shown on the screen, and each such bungalow was really an oasis of civilisation. It meant a higher standard of honesty and of justice; in various ways—in progressive cultivation, in helping the ryot with money, and in all his trouble giving him just that assistance which you expected in England from an English squire. And it meant that the planter was unconsciously a sort of policeman; the very fact of his presence prevented a considerable amount of fraud and oppression, especially amongst subordinate officials, which would otherwise go on. From this point of view, as an old official, he thought the importance of this question to the Government could not be over-estimated. If all this was to be swept away the Government would have to increase both its administrative and military machinery in those parts. In times of famine the Government had found in the planters of Tirhoot, a most efficient ready-made organisation—an unpaid administration—ready to

their hand, with men who could be implicitly trusted, and who, from their knowledge not only of the people at large, but of individuals, could be of more assistance than any imported official machinery. More than that, in the famine of 1875, before there were any railways in Tirhoot, the grain which Sir Richard Temple sent with such a lavish hand to the banks of the Ganges would never have got to its destination had it not been for the planters' assistance in bringing forward their bullock carts for transport. Of the remedies which had been suggested for the threatened danger he was not in a position to say much. He drew a marked distinction between on the one hand the synthetic indigo produced by the Badische Anilin und Soda Fabrik Co., which it was said could not be distinguished chemically from indicotin, and indigo substitutes on the other. In one case legislation on the lines of the Merchandise Marks' Acts, if necessary, would be perfectly fair and just, but he should hesitate to ask for it in the case of a product which was chemically indistinguishable from real indigo, and he very much doubted if Parliament would grant it. He feared the real danger came from the synthetic indigo and not from the substitutes, although the latter did tend to lower prices and so absorb a margin of the work hitherto done by real indigo. The real question was that of price, and it would have been a consolation if Mr. Rawson could have given any forecast as to the possible price at which this synthetic indigo would in future be produced. There could be no doubt as to the dangers, but the battle was not over yet, and he hoped the suggestions made as to the direction in which larger production and a better result in colouring matter might be obtained, would be duly considered.

Dr. J. A. VOELCKER said Mr. Rawson knew so much about his subject that he had found it hard to condense his material within the time at his disposal. He had dealt not only with the cultivation of indigo, but also with its manufacture, the chemistry of it, the process of dyeing, and many other points, which would require a whole course of lectures to treat properly. He had, however, given as concisely as possible a summary of the chief points which required to be known, and the chief points to be considered with regard to the future. Mr. Rawson was known amongst his brother chemists to be an enthusiast on the subject of indigo, and he seemed to have his whole heart in the progress of the industry. When he (Dr. Voelcker) was in India he saw how much there was to be done in pushing on this industry, and he thought so still more now. A distinguished organic chemist a short time ago sent a communication to the *The Times*, bewailing how many industries were suffering for want of the application of chemical knowledge, and he instanced indigo as a case in point. He lamented that there was no one working at it, and said as long as that was the case no progress could be expected. He was evidently not then aware that Mr. Rawson had already been out in India for two years, and w going out again for a still longer period. But thou not exactly true in this case, the statement w correct as a whole, and it did not redound to t credit of this country that there was so little e couragement to the application of scientific work industries, which depended very much for th success on advancing knowledge, and the const union of science and practice. In Germany thir were very different. The progress of chemical mar factures on the Continent had been owing very larg to the successful combination of science with the dustry. It was no exaggeration to say that where factory in England had one chemist employed, Germany you would find a hundred. What wonc that foreign competition was so successful. M Rawson had taken up a wise position with regard the competition of synthetic indigo. He had r tried to bolster up the prejudice of those engaged the industry by telling them that this new indigo w a different thing, and ought to be put in a differe class, or that it would not do as well as t natural product. They must face the fact th to all intents and purposes it was the same thir and that the only ground on which the co petition could be met was that of economy production. He was convinced of the possibil of getting a larger output of natural indig and in that direction they must look for reli His own observations in India showed h that a great deal was done in a very haphaza way, and that there was much to learn with rega to the selection of land and of seed, and knowled of the processes which went on during the man facture. It did not follow because a man got big crop that he got the most indigo; attenti should be paid to the production of colouri matter rather than of crude material. He doubt very much if planters generally had any cle idea of the effect which fertilisers would have increasing the production of colouring matter. The was still ample scope for improvement, and it w very wise to encourage men like Mr. Rawson carry out those inquiries which the present positi demanded.

Mr. F. A. SHAW said after all they had hea from Mr. Rawson, in reference to the Indi indigo industry, there was very little he co add, but there were one or two matters which thought bore on the subject. As far as he co ascertain, there was very little difference betwe the cost of dyeing cloth with natural indigo a artificial substitutes, and this was fully compensat by the superiority and lasting power of the form To the public this difference does not appear, as clot dyed with artificial dyes were priced quite as high those containing natural indigo; in many ca brought under his notice the latter were the cheape As had been pointed out, the superiority of t natural dye was proved by the fact that the An

l Navy had adopted it, in preference to artificial ·s, and they were in a position to test thoroughly respective value of the various dyes. The German horities having followed suit, was again a very ng proof in its favour, considering that nearly all substitutes were produced in Germany. All nches of the English trade were strongly in favour supporting home industries, and he presumed the glish colonies came under that heading. It must admitted that they had shown a strong desire to considered a part of the British Empire, by their hesion and anxiety to uphold its entirety and ional welfare. In the *Dyer, Calico Printer, acher, Finisher, and Textile Review*, of the 20th bruary, 1900, was published a report of the Silk sociation, for 1899, which stated that the Admiralty l acceded to the request that all ribbons should be ed as well as manufactured in the United Kingdom, l in their specification for the supply of black silk ribn, placed as one of the conditions "all the goods must of British manufacture, *i.e.*, dyeing and weaving." is showed the desire of the Government to support itish industries, and it might be reasonably expected it the trade would in like manner support British oducts, including natural indigo. The indigo trade fered from artificial substitutes filching the name. r centuries natural indigo had been known under it name, but now the various substitutes took it, l sold their goods as "pure indigo," "indigo," ndigo blue," and so on. If these substitutes were good as natural indigo they should sell as well by ir own proper names. In all trades Government otected goods from being sold under a false name, d it was to be hoped that this industry would be in e manner protected. The public desiring to buy th dyed with natural indigo were unable to ascern what dye was used, and did not find out that it s only a poor imitation until the cloth had lost its our, and even then the great majority were not in a sition to know the reason.

Mr. W. MARTIN WOOD said he believed indigo ıld be cultivated in the province of Guzerat, where . Alex. Rogers was Commissioner, and that an empt was once made, and successfully, but the lustry was stopped by religious prejudice. A holy n, who happened to know that just at the time en the plant was cut and plunged into hot water was covered with microbes, told his followers that ey were destroying God's creatures by the millions, d so frightened them that they refused to work any re.

The CHAIRMAN having formally moved a vote of anks to Mr. Rawson,

Sir CHARLES CECIL STEVENS, K.C.S.I., in conding the motion, said he desired to associate nself with every word Sir Steuart Bayley had said th regard to the enormous administrative importance of the indigo industry in Behar. He had considerable experience in the affairs of that Province, which he had had to deal with in every office up to that of Acting Lieutenant-Governor. He had frequently had occasion to ask advice and assistance from planters, and so had every officer who had served in Behar. He was confident that no officer had ever asked in vain. There was no one to whom the administration of Behar owed more than to Sir William Hudson.

Mr. RAWSON briefly responded, and expressed his satisfaction at the presence of Sir William Hudson.

Mr. W. S. SETON-KARR writes as follows:— Owing to the lateness of the hour, I had to compress my remarks on Mr. Rawson's excellent paper into a somewhat small space. I now reproduce them with some slight additions. The manufacture of indigo from the plant was carried on in India in early days, long before the arrival of the Englishman; and there is a well-known native fable about a jackal that fell into an indigo vat, and on getting out became an object of wonder and admiration to his fellows until a heavy shower of rain washed off the colour. But however ancient the cultivation of the plant, it has always been very subject to climatic influences. In fact, few agricultural operations in India are so much affected by heat and moisture or stand more in need of a timely rainfall. In Lower Bengal, distinct from the important districts mentioned in the paper, the indigo crop must be sown, grown, matured, and cut and carried, in the space of three months, or at the outside, in one hundred days. Here are no October sowings as there are in other parts of the Presidency. The planter looks for what is known as a "sowing shower" at the end of March or the beginning of April. The crop ought to be cut and carried by the end of June or by the middle of July so as to avoid an excess of rain or the rising of the Ganges, and what are called its "distributaries." A heavy and uninterrupted rain-fall diminishes the yield of colouring matter in the plant, and a sudden rise of the big rivers all over a vast expanse, might submerge the whole crop. Consequently, it is very desirable that the ground should be properly prepared and the seed planted early in April. Indigo is also exposed to damage by the cattle of the ryot. Bullocks and cows do not eat the growing plant, but they trample on it and injure its growth, as there are no fences except in the immediate neighbourhood of villages. I have referred to some figures and statistics in a Blue-book drawn up some 40 years ago, the accuracy of which there is no reason to doubt, and it may be instructive to compare them with the figures of the year 1900. There is, however, no reason to think that there is a very wide difference in the two epochs. Between 1850 and 1860 it was estimated that the annual out-

turn of manufactured indigo in the Bengal Presidency was over 100,000 maunds. The greater portion of this was supplied from Behar and Bengal, and the plant was cultivated by substantial ryots, or tenant-proprietors, who contracted to deliver it at the factory. It was estimated that 2,000 bigahs, sown with indigo, represented a capital of two lakhs of rupees, and an annual outlay of 12,000 rupees. In one district the outlay of factories exceeded that of the land revenue paid to Government. The expenses of manufacture alone were estimated to cost the English planter some 20 rupees per maund, and though in good and prosperous seasons, one maund of indigo might command a price of 200 rupees, the expenses of the factory, administration and supervision, the wages of servants, the adverse influences of climate, too much drought or too much rain, had all to be taken into account. Three or four good seasons in succession might give the planter an independence, and the same number of adverse years might spell ruin. It must be recollected that though we never can colonise the plains of India, factories, whether of indigo, cotton, or jute, represent property and wealth that can be transmitted to heirs for generations. I now desire to add my testimony as to the value of a great industry to the views emphatically and clearly expressed by Sir Steuart Bayley. Indeed, all Indian administrators whose opinion is worth having, within my knowledge and observation, have invariably set a high value on the residence in the interior in the country, of Englishmen and Scotchmen engaged in agriculture or commerce. Before the Mutiny, during the Mutiny, and after the Mutiny, the planter has been looked upon as an element of strength and a source of prosperity. In times of famine the factory supplies a ready-made organisation for relief and the supervision of works, and if at any time there is any friction between the Englishman and the native, between capital and labour, as there is in many other countries (England included), the result has lent animation and earnestness to Government and its administration. The presence of Englishmen in factories scattered over large districts furnishes a guarantee for the detection and redress of grievances. Natives will often endure a good deal in silence; the Englishman makes his voice heard; and when we are told that, in three large districts in Northern Behar, there are no less than 700 Europeans serving as volunteers, coming in daily contact with all classes of natives and conversant with their feelings, interests, and wants, it is easy to understand the value of such a body in troublous or peaceful times, in the development of natural resources, and in epochs of scarcity, sedition, or discontent. A good deal has been said in the paper read to us and by other speakers, about the possibility of a collapse of the planting industry owing to the discovery of other compounds and dyes capable of competing successfully with the natural product, and even ending by driving it out of the market. I am not qualified to offer a decided opin on a subject which is one for experts in chemistry manufacture, and on which there is evidently sc difference of opinion. Since the paper was rea have been informed, on most trustworthy author that the natural product is by some experts conside superior to the new dye because the latter is apt lose colour from wet and from ordinary wear and t Consequently I may still express a hope that ind manufactured in the Bengal Presidency may, fr warmth of colour and durability, continue to hold own in the market; and that we may not hear of collapse of important factories in Behar, where Englishman employs his capital, his energy, and integrity, in enterprise resulting in profit to himself advantage to the State.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 4, 1900; HERBERT MIL BIRDWOOD, LL.D., C.S.I., in the chair.

The following candidates were proposed f election as members of the Society:—

Adams-Randall, Charles, 5, Salters'-hall-court, E.
Anderson, Frederick, care of Ilbert & Co., Shangh China.
Delgado, Gershom, 17 and 18, Paradise-street, E.(and 256, Gloucester-terrace, W.
Galloway, Professor W., Cardiff.
Getting, James Charles, 4, Corbet-court, Gracechurc street, E.C.
Masson, William Pulteney, River-view, Darjeelin India.
Pease, Henry T., Veterinary-Captain, Veterina College, Lahore, India.

The following candidates were balloted f and duly elected members of the Society:—

Bolling, Randolph, Virginia Iron, Coal, and Co Company, Bristol, Tennessee, U.S.A.
Brain, Herbert Burgess, 61, Coleman-street, E.C.
Davar, Sohrab Rustomji, 9, Elphinstone - circ Bombay.
Deepchand, Veerchand, C.I.E., Pedder-road, Cur balla-hill, Bombay.
Doctor, Mervanji Rustomji, Colaba Sanatoriu Bombay.
Hildyard, F. W., Gwydr-lodge, Forest, Snaresbroo
MacDonald, David Johnston, South St. Roque Works, Dundee.
Master, Jehangir Rustomji, Chundanwady, Bomba
Mody, Limji Cursetji, Palli-hill, Bandora, Bombay.
Panday, Dady Cowasji, 13, Frere-road, Bombay.
Patel, Nadirsha Darabsha, Queen's-road, Marin lines, Bombay.
Wright, C. M. P., The Choukpazat Gold Minin Company, Limited, Nankan P.O., Mu Valley Ra way, Upper Burma.

The paper read was—

COTTON SUPPLIES.

By John A. Banister.

Ꮁo sustain the hope of adequately dealing in ͅsingle paper with the vast subject of cotton ɔplies one should possess, in addition to ɿost inexhaustible information, a long life- ɩe of experience, and infinite assurance. In these respects I can only deprecate my ɪciencies, but since, in regard to so great a tter, the wisest of us must necessarily be l continue learners, it is my hope that ɔuld I in any respect fall short of your ɔectation, the will to serve you may be taken the deed. I shall make no statement which ave not been at the greatest pains to verify, touching, as I shall necessarily touch, upon nts upon which many of you are recognised ɔerts, I shall myself be only too glad, in the ɔsequent discussion, in which I hope many you will participate, to learn from any who y be able to throw light upon this extremely portant and interesting subject.

n all industrial matters there is a tendency dissociate what are called the practical ɛds of the period, or of the moment, from the re picturesque elements, which the work of ure and the labour of man invariably ɔply. The British mind, excelling in power concentration and intensiveness, is not dily attracted to wider spheres of observa- ı than the exigencies of a particular trade craft, or a particular section thereof, may ɔpen to demand. It is true that we gain reby, inasmuch as our energies are not liable be dissipated in visionary speculation, but keynote of the present age is breadth, ex- ɪsion, development, unexampled in the tory of the world, and, as a nation, the first ɛssity for us is to avoid even the semblance lagging behind, or resting upon past mphs.

n the "spacious days of Great Elizabeth" ilisation, which comprises and is also in a y great measure synonymous with industrial ɔrt, received in England an immense im- us. When literature and the arts in general oke from the lethargy of the Middle Ages, n at last this land of ours began to realise strength and natural resources, and the ndations were laid of that industrial ɔremacy to which we have so long made im, and which we are determined to retain.

\s a result of the mineral wealth and other ysical characteristics of the North of Eng- d having attracted thither practically the entire cotton interests of the country, the majority of Londoners know very little indeed about cotton in the raw state, either as regards its cultivation or its manufacture. We are familiar from childhood with the terms distaff and spindle, not to mention spinster, but to most of us such terms remain abstractions, and I therefore ask your permission to briefly relate the history of cotton culture up to the time when precise statistical details become available.

Herodotus, Strabo, Arrian, Virgil, all, in various connections, make reference to "wool-bearing trees," and there is ample evidence in their writings and elsewhere that the cotton plant was extensively cultivated in India, at any rate, long before the Christian era. Columbus, in 1492, found the natives of the Bahamas ready to barter skeins of cotton, and in Cuba he found cotton cloth extensively worn. In Egypt and in China cotton has undoubtedly been largely grown for many centuries, but in the case of Egypt it is since 1821, when Mehemet Ali introduced the Sea Island variety of the *Gossypium Barbadense*, that the cultivation of cotton has attained commercial importance, and in China, where the cotton is moreover of notoriously inferior quality, the adoption of cotton clothing dates only from the 14th century, garments of wool and silk having previously been almost exclusively preferred, and cotton cultivated only as an ornamental plant.

Cotton is cultivable between 45° of north and 35° of south latitude, which zone includes the whole of two continents, Africa and Australia, very large portions of America and Asia, and the European shores of the Mediterranean. The European output is comparatively insignificant, the Australian negligible, and it is by America (North and South), Egypt, and India, that almost the whole of the world's supply is provided.

Like most of our other great national industries, the manufacture of cotton goods in England has been of slow growth. In the 13th century, cotton was in general use among us for candle-wicks, but it was not until the growing demand for imported stuff in Elizabethan times stimulated industry and enterprise that we hear anything of cotton-yarn spinning. It is, in fact, not till 1641 that definite mention of it is made by Lewes Roberts in his little book, "The Treasure of Traffic."

The cotton plant, from the striking appearance of its blooms, naturally did not escape

the observation of mediæval explorers in those lands in which it was cultivated. Many marvellous tales were told of the legendary "vegetable lamb" which, as one author expresses it, "grew on a tree bearing fruit or seed-pods, which when they ripened and burst open, were seen to contain little lambs, of whose soft white fleece Eastern people wove material for their clothing." Sir John Mandeville, who was a great impressionist in his way, declares the lambs to have been composed of flesh and blood, and claims not only to have seen, but to have eaten them. He admits that this was "a great marvel," which the critical reader interprets as a euphemism. In describing the territory of Prester John, however, Mandeville states that "men sow the seeds of cotton, and they sow it every year, and then it grows into small trees which bear cotton. And so do men every year, so that there is plenty of cotton at all times." The conviction expressed in the last sentence many of us nowadays would be extremely glad to share.

England was certainly one of the very last countries to adopt the cotton spinning industry. In Spain, Bavaria, Netherlands, and Turkey, the industry was established before the end of the 16th century. Lewes Roberts, however, writes of the industry as having been established "at Manchester in Lancashire" for some considerable time. After referring to Manchester enterprise in connection with the importation or weaving of Irish yarn, he says, "neither doth the industry rest here, for they buy wool in London that comes first from Cyprus and Smyrna, and at home worke the same and perfect it into fustians, vermillions, dimities, and other such stuffs, and not seldom send into forrain parts, who have means, at far easier terms, to provide themselves of the said first materials." We may be reminded by this passage of the fact that, until about 1780, the cotton imported into Great Britain came almost entirely from the Mediterrannean, from Smyrna chiefly, a very little occasionally coming from the West Indies during the 18th century.

Manchester cottons were constantly mentioned in statutes of earlier date, but it is generally understood that these were a coarse kind of woollens, and, as a matter of fact, until 1773 linen yarn was used as the warp for nearly all cotton goods, and the production of unmixed goods was exceedingly limited. A great deal of confusion arises in the historical study of cotton from the constant use of "cottons" as a term for woollen fabrics, but it is considered proven that the manufacture [of] cotton goods was introduced into Engla[nd] towards the close of the 16th century by t[he] Flemish Protestant immigrants, just as, mu[ch] later, the Spitalfields silk-weaving industry w[as] established by the French Protestant refuge[es] after the revocation of the edict of Nantes.

In 1538, Leland states that "Mancestere, [on] the south side of the Irwell river, standeth [in] Salfordshire, and is the fairest, best builde[d,] quickhest, and most populous tounne of [all] Lancastreshire." In 1699, in which year t[he] entire exports of the country was considerab[ly] under £7,000,000 in value, the cotton tra[de] had become sufficiently productive to encoura[ge] the general erection of brick houses in Ma[n]chester, the population of which was th[en] estimated at about 50,000; but that this pro[s]perity was not wholly due to cotton is evide[nt] from the fact that two years later the export[a]tion of woollen goods amounted for the ye[ar] 1701 to £2,000,000, more than a fourth of t[he] whole export trade of the kingdom, while t[he] cotton goods exported in the year did n[ot] exceed in value £20,000. In 1833, it is interes[t]ing to note that the cotton goods exports we[re] nearly £19,000,000, and the woollen expo[rts] only about £6,500,000, while in 1898 t[he] exports of cotton and woollen manufactur[ed] goods were respectively about £56,000,000 a[nd] less than £20,000,000. As an indication of t[he] marvellous increase of production and of t[he] relative importance of the two industries, the[se] figures are worth quoting. A writer in 16[..] speaking of Leland, says, "He called Ma[n]chester the fairest and quickest town in t[he] country; and sure I am it hath lost neith[er] spruceness nor spirits since that time," a[nd] I may add since that time. It is becau[se] Manchester in 1894, with the completi[on] of the Ship Canal, began a new lea[se] of prosperity, because, as a port, its wea[lth] and importance are certain to become [..] greater than they ever could have been wh[ile] it remained an inland town, that such impre[s]sions of old writers convey peculiar interest [to] us. Manchester, in a sense, is the cott[on] industry, and the prosperity of the one [de]termines that of the other. The Ship Ca[nal] enables material to be consigned to the ve[ry] spot where the spinner awaits it, and [is] now rapidly meeting with the universal app[re]ciation it deserves, as a considerable savi[ng] in freight charges, &c., is affected by the p[ro]ducer of yarns. It is confidently expected t[hat] before long a cotton market will be establish[ed] in Manchester on the lines of the Liverp[ool]

lags." Very many raw cotton transactions :e place daily on the Manchester Exchange, d with the improved facilities for the storage cotton at the Pomona Docks, the advantages a reliable business in "spot" cotton to the ınchester consumer are obvious.

Among cotton-producing countries, India s spun her own raw material from the ·y earliest times. The protectionist senti- :nt which, formulated in a statute of illiam III., forbade the importation of Indian nted calicoes for domestic use, either as parel or furniture, under a penalty of £200 the wearer or seller, is constantly in evidence the history of the cotton industry, and no untry has suffered more in consequence. It ıy be questioned whether it is not just cause of that vigorous opposition which the tton industry has encountered at every stage its progress in this country that it has tained its magnificent prosperity; but in the th century, after the introduction of spinning ıchinery, the profits of the manufactured port trade to the Indies was so highly valued at in every possible way the native manu- cturer of cotton goods was discouraged. The overnment attitude was not by any means at of the 17th century pamphleteer, who wails the growing popularity of cotton licoes because they are cheap, and recom- ends the prohibition of stage coaches on count of their injuring the proprietors of the ns on the road by conveying the passengers o quickly and at too little expense to them- lves. We can, nevertheless, only regard as perversion of national judgment the imposition a duty of 10 per cent. upon Indian cottons ıported here, while English cottons imported to India only paid a duty of 2½ per cent. In e 18th century nearly all the Governments of urope felt it necessary to prohibit or impede e importation of Indian cotton fabrics, and e result of this was necessarily that as a centre the cotton goods manufacture India dete- orated. The slow introduction of machinery ıd properly equipped mills has operated gainst the development of Indian yarn spin- ng and manufactures, and is still prejudicial. When we come to the year 1781 we find the rst imports of cotton from Brazil, the West ıdian crops being unobtainable as a result of ıe war with France, Spain, and the American olonies. A very large increase in consumption imulated production in Brazil, and in 1788 ıe demand having grown immensely by this me as a result of the extensive adoption of ıachinery, the East India Company were urged to promote the importation of raw cotton from their territories. The result of this was unsatisfactory, for when samples came to be submitted Manchester spinners declined to buy—"the quality was unsuited." More than once large consignments of the East Indian product were rejected by spinners and thrown upon the hands of the producers, and it is only in comparatively recent years that the staple has been sufficiently improved, and enough care shown in the picking and various processes anterior to export, to enable Indian cotton to compete in the same markets with American. To come down to the present, the manufacture of textiles and the cultivation of cotton for export are conflicting interests in India, though the conditions of both have suffered many changes in the past hundred years. India depends on her indigenous staple for the supply of her steadily increasing number of mills. Japan, more particularly, shows an eager demand for raw cotton from India. It has come to the point now that unless the cotton acreage of India, which has recently greatly decreased, is considerably extended, manufacturers and ex- porters will come into active collision, to the serious detriment of one class or the other, or of both. We are indebted to the *Times of India* for a valuable article which appeared last month on the cotton acreage, in which the importance of rapid and extensive increase is emphasized. Japan being India's best cus- tomer for raw cotton, and a constant and growing demand coming from that country, it is urged that the restriction of the cotton area involves a menace to the Indian manufacturer in every bale that is sent abroad. The writer continues:—"While the cotton crop for the season ending June, 1899, was one of the largest on record, the one for this season will, there is no doubt, be one of the smallest; but, leaving these two years out of our review, as polarizing extremes, an examination of agricultural statistics over a fairly long period of years, is not exactly reassuring. The fact is that while the area in India sown with crops of all kinds steadily increases, the cotton crop area remains more or less stationary; and indeed bears a less proportion to the whole cultivated area than it did many years ago. For instance, in 1884-85, the total area in British India sown with crops was 125,955,122 acres. By 1897-98 this area had expanded to 196,497,232 acres. In 1884-85 the cotton area was 8,521,178 acres, and in 1897-98 it was only 8,916,229 acres. The curve of cultivated area has, in some years, gone up very high. For instance, in 1890-91, in

British India alone, it reached nearly 11 millions of acres, and in 1893-94 it touched nearly $10\frac{1}{2}$ millions of acres. But with the exception of last year the cultivated area has been steadily shrinking since 1893-94." . . . "So far as British India is concerned, the Government statistics estimate the whole cotton produce at about three million bales, of which the mills in 1897-98 are estimated to have taken 1,301,000 bales. To state the problem roughly then—very roughly we admit—a doubled mill consumption would about knock the bottom out of our export trade, or a doubled export trade would render the mill industry an impossibility."

That in India either the culture of cotton or the manufacture of cotton goods will decay is scarcely conceivable, but while the natives of India in the past have produced incomparable handspun yarn, it is exceedingly unlikely that they will, for many years to come, produce anything in the mills that will compete with the finer counts of English yarn, such as are turned out by the more skilful class of English operatives. Our great dependency which has her share in the industrial prosperity which we may all assist—be it ever so humbly—in securing for the British Empire, and the imagination is powerless to grasp what India may be industrially in even half-a-century, given due development of her resources. But the centralisation of the English industry in and about Lancashire, and the advancing technical education standard of the North of England, which is making rapid progress and bringing us on a level with the most enlightened nations on the Continent—these will give manufacturers here an immense advantage as regards the quality of products, howsoever much the Indian staple may be improved. As regards supplies, however, the day is not far distant when India will find more profit in the manufactured product than in the export of the raw material, that is to say, very little raw cotton will be left for export, even though the acreage be materially increased. India may be regarded as the home of cotton culture—she has been called the "cradle of the cotton industry"—and she may be considered entitled to the precedence I have given her, if only in deference to the antiquity of this market, but it must not be forgotten that it is from the United States that more than two-thirds of the world's supply was last year obtained, and that it is thence that a similar proportion will probably proceed for ma years to come. It is this cotton culture pe haps more than anything else that has broug the United States into the forefront of co mercial enterprise, by promoting consta contact with European peoples, and by stim lating industry and commercialism througho the length and breadth of the country. It is tr "a great marvel," to use Mandeville's expre sion, that one of the first recorded importatio of United States cotton, consisting of eig bags, received at Liverpool in 1784, short after Great Britain acknowledged the i dependence of the United States, shou have been regarded by the Customs autho ties at Liverpool as a breach of the existi navigation laws. It was assumed that th cotton was the product of Brazil, or t West Indies, and the statutes did n permit the conveyance to English ports l the vessels of a foreign country of the pr ducts of other countries. It was doubt whether so large a quantity of cotton a eight bags could have been raised in t country adjacent to the port of shipment.

It was the development of machinery t wards the close of the 18th century th created an increased demand, which Ame can cultivators found it well worth their whi to supply. The inventions of Lewis Pau Arkwright, Hargreaves, and Crompton, a conspicuous and venerated in the nation economic Pantheon, so enormously advance manufacture that while in the first half the 18th century the quantity of cotton-wo imported seems to have a little more tha doubled, and the value of the cotton e ports to have not quite doubled; in the la twenty years of that century the imports cotton increased eight-fold, and the value the exports of cotton goods was increase $15\frac{1}{2}$-fold.

When the Civil War of 1861-1865 wa foreseen, in view of the terrible consequence which must ensue to the cotton industry Lancashire, every accessible part of th cotton zone was ransacked for cultivabl areas. Seed was sent broadcast to all wh would experiment with it in likely region but the results were disappointing. Durin the cotton famine years prices rose so hig that even the European acreage was eno mously increased, speaking proportionatel and considerable quantities were shipped fro Mediterranean ports. But generally, after little adjustment had taken place, the rela tive importance of the products of the cotto

ducing countries became again pretty ich what it had been before the war and cotton famine which accompanied it. r dependence upon the American crop is atively as great as it has ever been, and ugh Egyptain cotton meets with a grow- demand from the spinners of the finer ints the crops available from the rest of cotton-growing countries do not largely rease, and there is the same anxiety wadays to discover, if possible, new areas profitable cultivation that there was in the e fifties.

The exports from Brazilian ports last year, instance, were under 200,000 bales, as npared with 214,000 in the previous year, d 278,000 in 1896-7.

It is probable that the United States will ntinue to absorb an increasing proportion of ch crop in their own mills, as will India, and it the surplus for export will accordingly ninish. Whether Egypt, too, has a future as manufacturing country is an interesting oblem. But bearing in mind the very small nsumption in this country of East Indian tton—less than $2\frac{3}{4}$ per cent. of the whole out- t last year of 1,415,000 bales—and also the idly growing continental competition in rns as well as in manufactured articles, th its tendency to reduce prices, the con- sion to be drawn is that the encourage- nt of cotton culture on a largely increased ale in every one of our colonies capable of dertaking it, and in fact in every area avail- le for the purpose, is a national duty.

In this current year it is anticipated that the nerican cotton crop will not exceed 10,000,000 les, as against 11,275,000 last year. Beyond at the crop will be considerably less than autumn estimates indicated, there is still nsiderable doubt and anxiety on the subject. ncashire spinners have largely followed 11,000,000 bales estimate of Mr. Henry ill, of New Orleans, in virtue of his high utation and remarkable success in previous ars in predicting the yield. This estimate has since reduced to 10,000,000 bales; t very few are now inclined to accept s reduced estimate, and if the deficit oves anything like so great as many con- ently predict, something in the nature of crisis must inevitably arise. In fact, the estion of short time in the mills is der consideration in North-East Lanca- ire at the present moment. The plague d famine will have thei effect upon the dian output this year. Egyptian crops, owing to the state of the Nile, will probably be very much diminished next season, though the latest reports are more favourable. From various causes the confidence of spinners in reports from the other side, regarding the American crop movements, has been much shaken, and the situation is altogether of an exceedingly problematical character. I do not, however, propose to offer a speculative opinion on the American crop prospects. It is too late for any useful opinion to be expressed, and the remarkable and unprecedented divergence of responsible expert opinions, the paramount feature this year, is scarcely encouraging, while I am no authority on the subject, and could not speak as an expert.

There is this, however, to be said. On this side no one is able to regard seriously the present inflation of prices in New York, and it is anticipated that during the next few months speculators and manipulators will control the market. No one knows how to act for the best, and the Lancashire spinners buy only for urgent requirements. The same speculative intrusion which for a time demoralised wheat and rubber in turn has now affected cotton.

I should like to quote in this connection the opinion of an American journal, *The American Ginner*, published at Meridian, Missouri :—

"The cotton crop of America, enlisting, as it does, the interest of every civilised country on earth, furnishing raiment to the nations, has been hitherto considered too vast in its proportions and two wide in its ramifications of influence to tempt the octopus. But it appears that the magnitude of the enterprise has been an inspiration and an inducement to the endeavour. The very greatness of the enterprise has seemed to invite rather than repel the endeavours of some who have achieved great things in other similar but smaller undertakings. It would seem as if stupendous success in the circumscribed field whetted the appetite for greater worlds to conquer, and there are many evidences plainly discernible to the intelligent observer who looks beneath the surface, that such an enterprise has been planned, and the process of extention begun. The Napoleons of finance who undertake these stupendous enterprises never make an assault *vi et armis*—the waiting siege, sapping, and mining, constitute their method of operation and approach to the citadel which they desire to capture. Once surrender the preparation of cotton for market to a monopoly, and where then is the hope of the producer or consumer? Once establish the warehouse system of storage, and who controls

the market? These two agencies combined fulfil all needful means to accomplish what is known as a corner, and when they become generally adopted, the producer on the one hand must take the price offered, and the spinner on the other must pay the price asked, or the alternative. The grower's cotton must rot on his hands and a famine of cotton goods produced. . . ."

I will add no comment. It is curiously interesting to compare the exports of cotton from the United States a century ago with those of the present day. Baines, in his "History of the Cotton Manufacture," writing in 1834, describes as immense the American crops of the years 1819-1832, which ranged from about 300,000 bales of 300 lbs., to rather more than 1,000,000 bales of 300 lbs: in 1791, the entire exports of cotton from the United States was 189,316 lbs. weight; last year the American cotton crops amounted to nearly 11,250,000 bales, averaging 487 lbs. in weight, or considerably over 5,000,000,000 lbs. weight of cotton.

It is unfortunate, seeing that the use of yarn for mercerising processes has brought a great deal of business to the spinners of the finer counts in the Bolton district, that the Egyptian crop this year is likely to fall far short of the demand. Egyptian cotton commands a high price, and is a very bright feature in the outlook for that country's commerce. But there can be no kind of doubt that in a few years, when the irrigation system in process of adoption is thoroughly established, the cultivable area will be enormously increased. The crop prospect is this week reported to have very much improved, owing to the progress made in cutting the sudd.

There are students of political and social economy who compare the present age, following as it does on a period of the most active invention and scientific expansion, with those ages of degeneration, or of repose, which followed the fall of the Roman Empire and the Reformation. It is argued that the principle of evolution in cycles demands a periodical cessation from activity in industrial enterprise and in all other matters, and special application of this theory is made to the present condition of our national industries. But it is to be questioned whether sufficient allowance is made in speculations of this kind for the quite unprecedented changes in the whole economy of human affairs which the closing century has witnessed. There is no parallel in the history of the world for the advances comprised in the life of man since the age of Napoleon, to take the cen figure of the period. Space has been i great measure annihilated. The resource steam and electricity have placed the lif the Antipodes in immediate juxtaposition to own, and the obvious deduction is that s things as may appear requisite for the well-be of humanity, or any section of it, it is no longe the power or discretion of any particular na to withhold. It is in the nature of man seek rest when his task is finished: nati when they have accomplished a feat of in tion, an industrial forced march, a miracl contrivance, which has placed them in a p tion of relative superiority to their competit are prone to meditate awhile and sooth leisure that is itself gratifying, in contrast the effort concluded, with self-adulation what has been accomplished. But no na can now afford to do this thing with impun Whatever may be the ties which bind one pe to another, the essentials of civilised life, and life which are the basis of commerce, fo clothing, and shelter, control their dome requirements, and ultimately determine t financial and political neutrality. Therefor is that the principle of the machine, untiri unresting, has been imparted to human in course in general. Each new advance science secures universal comprehension application almost as soon as promulgat woe be to the nation that ignores, or jects, the signs of progress, for while rapidity of advance is unprecedented, shall it be in those dynasties of industry t decay?

This nation is not decadent, but we h been lacking in aggressive vitality, albeit have served as the industrial model for ne nations, which have not failed to profit by humour. But as we have been led by rec events to analyse the ethics and tendencies our foreign policy, so also is this a criti period in our industrial life, and a fitting t to recognise the altering conditions. Co mercial monopolies, howsoever acquired maintained, the future will condemn strenuously as the past, and to some ext the present, has upheld and upholds the but where the element of transport, except a factor in cost, becomes negligible, the worl supply of any kind of raw material whatsoe will necessarily be derived from those count which can best produce it, and since in reg to cotton supplies an acreage of perhaps millions, or a tract of land about half the siz England, would probably fulfil all requireme

r a long time to come, so far as the ultimate ture is concerned it is simply a matter of lection.

That the United States will ever cease to oduce a large proportion of the world's tton supply is most improbable, but that e United States will multiply its mills and nsume an increasing proportion of its crop scarcely a controversial statement The estion for England is whether, while we are a position of supremacy as regards wealth d resources, our interests do not desiderate pitalisatiou of all available new fields of pply for our industrial needs. The trend commerce, sooner or later, will be to anufacture all articles of the world's conmption in the immediate neighbourhood the producing area of their material, and en under present conditions it is a curious omaly that the model centralised industry, the tton trade of Lancashire, should be estabshed in a land that never has been and never uld be made to grow cotton. But pending the velopment of the principle of manufacture the fields of supply, which the annihila- space—the salient fact of the 19th cenry, as it seems to me—is bringing into the gion of practicability, our industry deands the utilisation of every available area supply, and the problem presents itself w very much as it presented itself in the ties.

The climatic essential of cotton culture, uable but at no time excessive moisture, hardly to be found in Australia, and, erefore, the experiments undertaken there ve been at best inconclusive. Wool culre, moreover, provides a profitable industry which the climate of this continent is culiarly suited. But this is not the case th regard to a great part of Africa. In est Africa cotton has been cultivated by the tives for centuries. In 1890, cotton cloth m the Guinea Coast was brought to England. r. Ellison, in his "History of the Cotton ade of Great Britain," writing in 1886, timates the quantity grown in Africa, apart m Egypt, at about 150,000,000 lbs., or 5,000 bales of 400 lbs., equal to 2·99 per nt. of his estimate of the world's crops. To e his words: "A large quantity of cotton is own in the coast places and interior of frica, but one can only guess at its amount. s the natives are for the most part more onomical than fastidious in the matter clothing it will perhaps be sufficient to timate the requirements of all Africa at an average of $1\frac{1}{4}$ lb. per head per annum, or one-half the per capital rate adopted for India." He then estimates the population at 200,000,000, deducts from the 250,000,000 lbs., so obtained a probable total of 100,000,000 lbs. imported in the form of cotton fabrics, and obtains the result stated, 150,000,000 lbs. weight. African fabrics are coarse, and useless for foreign consumption, but that the staple of the indigenous cotton is incapable of improvement is far from proven. The results obtained in Egypt in 1821, from Mehemet Ali's importation, would justify much more extended experiments on African soil.

I am deeply sensible of the privilege of appearing before the most critical, because the best-informed body in the kingdom. But I am naturally diffident in addressing your Society, and it is possible that what I have said may appear to you to convey too little concrete information. On such a subject one is compelled to risk being either diffuse or parochial, and I have elected the former course. If I have in any degree failed to interest you, I trust that I have escaped the utterance of any statement or the expression of any sentiment which might mislead you, and that my paper, if only for the discussion it may be privileged to evoke, will not be without utility.

DISCUSSION.

The CHAIRMAN, in opening the discussion, expressed, on behalf of the meeting, its cordial acknowledgment of the excellence of Mr. Banister's paper. Though Mr. Banister had modestly disclaimed the position of an expert, he had told them much which could only have been acquired by long familiarity with his subject and by association with those who were experts; and the meeting therefore appreciated the conclusions he had arrived at as of special value. He (Mr. Birdwood) could not claim to be an expert at all, and if he had ventured to take the chair that evening it was only because of his lifelong interest in the development of the material resources of that portion of the Empire which Mr. Banister had described as "the cradle of the cotton industry." His remarks would be few and would be such only as were suggested by his Indian experience and by the present circumstances of the country. It was nearly 40 years since he had been first enraptured beyond expression by the glorious sight of the rich cotton fields on the banks of the River Nerbudda in the neighbourhood of the ancient City of Broach—the Barygaza of the Greeks—and for many years he had lived in the cotton districts of Guzerat, and for a year also in the north-eastern part of Kathiawar, the home

of "fine Dhollera." It was a perpetual pleasure to watch the growth of the plants year after year, and to see them in the full livery of gorgeous golden bloom, and to be present at the in-gathering of the snow-white fleece of the bursting "pods" by women and children throughout the countryside. Surely, since the world began, since the days "when Adam delved and Eve span," the earth could show no fairer, no more pleasant sight. What a sad contrast was presented by the aspect of those very tracts at the present moment of famine and desolation. Though there had always been famines in India yet this was the first time within the knowledge of the present generation that there had been a cotton famine. In the Bombay Presidency the cotton crop this year was only one-tenth of the average crop; and in all other parts of India about four-tenths. The loss to the country from the failure of this single product had been estimated at about £7,000,000. It might interest the meeting to know that the price of cotton had been doubled in India by the famine. It was 2½d. a lb. before the famine, and is now 5d. a lb. But this higher rate is far below the price reached at the time of the American war, when cotton touched 2s. a lb. and more. It was to that war indeed, and the prosperity it brought to the Indian cultivator and exporter, that Bombay is indebted for its magnificent array of noble public buildings. Though the present position of the cotton industry in Bombay was most disheartening in view of the proposition affirmed by Mr. Banister as to the importance of the development and utilisation of every available area of cotton supply, yet there was no need, so far as India was concerned, to fear any curtailment of the area under cotton cultivation. He based this opinion on two general considerations. The climate favours the growth of the coarser kind of cotton, and it also favours the use of the coarser kinds of cloth made from such cotton. As long as the cultivator found a market close at hand for his products, the area under cultivation would not have to be reduced. The figures quoted by Mr. Banister from the *Times of India* did not show that there had been any actual reduction in the acreage of cotton cultivation. It had simply not increased *pari passu* with other kinds of cultivation. Now even as regards hand-loom weaving, it still held its own in India; for a vast proportion of the population wore only such garments as were worn before the art of sewing was known in India—garments woven without a seam throughout, which came from the loom in the precise shape in which they were intended to be worn—such, for instance, as *sáris* and turbans, for which there was a large market not only in India, but in Muscat, and in the Arabian ports and the East Coast of Africa. Then, again, though Indian mills could not compete with Manchester as regards the finer class of fabrics, of which only a very small quantity is made in India—as, for instance, at Ahmedabad, where, as Mr. Enthoven tells us in his admirable pamphlet on the "Cotton Fabrics of the Bombay Presidency," fine yarns of English manufacture are woven fabrics of great finish, which should hold t own with similar goods from the Lancashire loom yet, as regards coarser goods, made from yarn about 20's count, the local mills completely the imported cloths. There are 102 mills in Bombay Presidency—three times as many as in rest of India. In 1869 there were only 13 in that Presidency. In 30 years the number spindles increased from 285,524 to 2,706,710, the number of looms from 3,579 to 27, and the average number of hands daily emplo on mills from 7,357 to 97,747. In 22 years number of bales (of 392 lbs. each) consumed the mills increased from 74,924 to 974,092. Th figures show that there is a growing market the cotton locally produced, whether the manu tured articles are used in India itself, or exported they largely are now, to Japan. And so long there is such a market the area under cultivation not decrease. In happier days we may hope tha will largely increase, though we have no ground hoping that an improved staple will be produced, long-continued efforts of the Government in direction having so far produced no very apprecia results. He concluded by proposing a hearty vote thanks to Mr. Banister for his paper, which he sure would be read with the greatest interest.

The vote of thanks having been carried unanimou

Mr. Banister, in reply, said he trusted the f and ideas he had put forward would bear fruit. had been much interested in what the Chairman said with regard to the native industry in In Though cotton wns being largely exported f India to Japan, the Japanese were being approac by American producers, and it was a question whet in the near future, American cotton would not t certain extent compete favourably with the Ind but that could only be for spinning finer co than 20's; the great bulk of Japanese spinn was in 16's, and there the American cotton c not possibly compete, either with regard to cost or utility with the Indian product, which wo always hold its own.

Miscellaneous.

THE ETYMOLOGY AND DISCRIMINATI OF VERMILION AND OTHER RIT LISTIC REDS OF THE GREE ROMANS, AND HINDUS.

By Sir George Birdwood, K.C.I.E., C.S.

Vermilion is one of the salient, imperative, superlatively splendid reds, regarded in India, elsewhere in the East, and in Antiquity, as signifi of divine power and glory generally, and in som

[the]ir denominations as dominically consecrated to [par]ticular divinities. In India these reds are :—

[1],—Kermes, Crimson, or Carmine, the female [Coc]cus Ilicis, found on *Quercus coccifera*, the "[K]ermes Oak" of Asia Minor, and the Mediterranean [cou]ntries generally, and before the introduction of "[C]ochineal," the female of *Coccus Cacti*, found on [*Op*]*untia cochinillifera*, the "Cochineal Fig" of [Me]xico, universally used in the Old World for dyeing "[cr]imson"; it being the *toleath* [literally "worm"] [of t]he Old Testament, almost always translated in the [En]glish Authorised Version by "crimson," or "[sc]arlet," the word "worm" ["vermis"] being [und]erstood [in Exodus xxviii. 5, the Hebrew *toleath* [*sha*]*ni*, translated "scarlet" is literally "shining [wor]m"]; the κόκκινος of the New Testament [M]atthew xxvii. 28, &c.]; the κόκκος, Kermes-[b]erry," of Theophrastus; and the κόκκος βαφική, "[D]yeing-berry" of Dioscorides.

[2],—Lake, the female of *Coccus Lacca*, found on a [vari]ety of trees in India, not solitary like Kermes, but [em]bedded in a gum-resinous exudation, the "stick [lac]" of commerce, in "hundreds of thousands," *i.e.*, "[la]*khs* upon *lakhs*"; whence the Hindus call both the [gu]m-resin, and the colouring matter [female *Coccus*] [wash]ed out of it, *laksha*; we calling them respectively "[la]c," and "lake": the residuary gum-resin being "seed lac," aud this melted down the "lump [lac]" and this remelted and run into thin layers, the "[sh]ell lac" of commerce, used in the preparation of [seal]ing wax ["Indian wax"], and the hard, glassy [var]nishes distinguished as lacquers.

[3],—Gum Dragon, the gum-resin of *Pterocarpus* [*Dra*]*co* of Socotra [and the "Spanish Main"], [*Cal*]*amus Draco* of Sumatra, and *Dracæna Draco* of [the] Canaries; the κινναβάρι Ινδικόν of the Greeks, the "[C]innabaris" proper of the Romans, and *dam al* [*akh*]*wain* of the Arabs, and, through them, of the [Hi]ndus; but also included by the latter, together [wit]h the gum-resin, "Malabar Kino," of *Pterocarpus* [*Ma*]*rsupium*, under the term of *dhaksha*, or *dhak*, [the] gum-resin ["Butea Gum"], properly speaking, of [*Bu*]*tea frondosa*, the *palasa* [whence the name of the [tow]n of Plassey], *kinuka*, *kinini*, or *kinsuka* tree: [and] possibly the local bazaar term *dhak*, carried into [Eur]ope by the Arabs, gave rise to the classical fable [of] "Indian Cinnabar" being, as Pliny recounts [xxx]iii, 7 (38)], the mingled blood of fell dragons and [mig]hty elephants torn and crushed in mortal combat: "sic enim appellant illi saniem draconis elisi [ele]phantorum morientium pondere, permisto utriusque [ani]nalis sanguine": the Arabs then carrying their [tran]slation, *dam-al-akwain*, of "sanies Draconis," [bac]k to the bazaars of Western India. But compare [wha]t is said below under Realgar and Minium, and [also] the Puranic fable of "Daksha's Head."

[4],—Red Ochre [ὠχρός "pale"], including in this [term] the various iron-moulded clays found under the [late]rite of southern India, generically named *pendi*, [and] also specifically distinguished by such local names [as] *lokhandi-matti*, "irony earth," *tamvadi matti*, "coppery earth," and corresponding with the Armenian [*Armini matti* of Indian *bazaars*], Sinopic, Lemnian, Ballearic, &c., earths of the ancients; the μίλτος proper of the Greeks, with which they drew the carpenters "red line" [μίλτεῖον στάγμα]; the "rubrica" of the Romans, with which they inscribed the title of a law [whence "rubrica" "a law"]; and our reddle or ruddle; we now, through the mediæval writers, applying the term "Rubrica" to madder root, "rubea radix," the ἐρυθρόδανον of the Greeks, and to our "madder reds" generally.

5,—Realgar, Rissigallum, or Red Orpiment [*i.c.*, Auri-pigmentum, Yellow Orpiment], Red Sulphuret of Arsenic, the σανδαράκη of the Greeks, and "Sandaracha" of the Romans; the *manashila* or *manshal* of the Hindus [their *haritala* or *hartal* being Yellow Orpiment]; and the "Sandaracha Græcorum" of the old pharmacists; who thus distinguished it from their "Sandaracha Arabum," "gum Sandarach," or "Citrine resin," produced by *Callitris quadrivalvis* [ξύλον θύινον, of Rev. viii., 12] and certain other Coniferæ; which was confouuded by the Arabians with the classical Sandarach, probably in consequence of a practice, noticed by Dioicondes [v., 122], among the Greeks and Romans, of burning the latter drug with resin and inhaling the smoke through a tube, in the same manner as Realgar is prescribed by the Indian *hakims* at the present day. The "Sandyx" of the Romans, the σάνδυξ of the Greeks, was a reduction of equal parts of "rubrica" and "Sandaracha." Owing to the application of the term by Virgil, in Eclogue iv., line 45, commentators have suggested that it must have included a vegetable dye [*cf:* Ducague—"Sandarax, herba de qua tingitur blavus colour"], but the term is cited here simply in association with the terms Sandarach and Cinnabär.

6,—Minium, now, only Saturnine Red, or Red Oxide of Lead, but confused by the Greeks with μίλτος, and by the Romans with their "minium," although Pliny distinguishes it [xxxiii. 7 (40)] as the "alterum genus [minii]," and "secondarium minium" from Vermilion; the *shashar* of Jeremiah xxii. 14, and Ezekiel xxiii. 14, translated in the A.V. by "vermilion;" the *siranj*, [intensitive (literally "thirty-fold") colour], one of the epithets applied by the Persians to the Almighty] of Avicenna, though some identify his *siranj* with Vermilion; and the *sindura*, and [in Western India] *sandur* proper of the Hindus, mythologised by them as the blood of the demon Sindurasura, slain by Ganesa, or Ganapati.

7,—Cinnabar, or Vermilion, Red Sulphuret of Mercury, the κινναβάρις proper of the Greeks; the "minium" proper of the Romans, at least of Pliny, as also of the mediæval miniaturists, scribes, and illuminators; the "cennobrium" of "Theophilus the Monk;" the *siranj* or *saranj*, *shangarf*, and *zanjifrah* proper of the Persians, and *shangraf* proper of the bazaars of Western India; and now always under-

stood by the ancient classical, and still unexplained name of Cinnabar.

I have thus formally identified these reds to avoid entanglement in the extreme confusion of their nomenclature, not only in the writings of the Greeks and Romans, but in the popular parlance of the Hindus; in which last the names of Red Ochre, Minium Cinnabar, and even of Realgar, are more or less interchangeable; those of Minium and Cinnabar being absolutely interchangeable. It is impossible in this place to clear up all this confusion; or to do more than throw out the bare suggestion that *σανδαράκη*, and *κινναβάρις*, have, in their undoubtedly complex etymology, at least one root in common. One root may be the Sanskrit [Aryan] *chandra* [cf.: Semitic *shani*—"shining"] the Moon, *i.e.*, "the Shiner," which reappears in Sandracottus, candle, candid, cantharides, incense, and kindle, &c. Sandyx, or *σάνδυξ*, has already been suggestively etymologised as "*shani*"—dyx, *i.e.*, "shining"—dyx, and this "dyx" may refer ultimately to *dhak*, or "Butea Gum," and "Malabar Kino." The term *Σινωπική*, ["rubrica Sinopica"], certainly entered into the mediæval term "Cennobrium" [sicut, "Sinopidem],'' and the Old English Cinoper, &c., meaning Cinnabar. But confused as the popular nomenclature of these reds among the Greeks, and Romans, and the Hindus, may be, there is, at least among the Hindus, no confusion in their ritualistic application; the country-side phallic stones, to be found along every road, however retired, in India, and in every high grove, being invariably daubed with Red Ochre; while the images of Ganesa, or Ganapati, are painted with Minium [Red Lead], and the scarf of Krishna with Cinnabar [Vermilion]. The rural deities of ancient Italy would appear to have been similarly rubricated. Virgil, in Eclogue vi. lines 21, 22, represents Ægle, the fairest of the Naiads, as painting the brows of Silenus with mulberry juice:—

> "Sanguineis frontem moris et tempora pingit."

And in Eclogue x. lines 26, 27, Arcadian Pan as reddened with the juice of elderberries, and "minium," here, probably, Red Ochre:—

> "Pan deus Arcadæ venit, quem vidimus ipsi
> Sanguineis ebuli baccis minioque rubentum."

Ovid qualifies Priapus, in Fasti vi. 319, as "rubicundus," and in line 333, as the "ruddy keeper of gardens":—

> "At ruber hortorum custos Nymphasque Deasque captat."

And in i. 415, as "red Priapus," the guardian and glory of gardens:—

> "At ruber hortorum decus et tutela Priapus."

Again, Pliny tells us, xxxii. 7 (36), that it was the custom in Rome to colour the face of the statue of Jupiter with Vermilion ["minium"]; and Pausanias, that the image of Dionysos, at Phigalia [viii. 39], and his bronze image at Phelloe [vii. 26], were painted with Vermilion ["cinnabar"], that his wooden image at Corinth [ii. 2] was "adorned with red paint," [ix. 32] that an elaborate image of Dionysos, i private house at Creusis, was "painted red."

Realgar, in Low Latin, Rissigallum, is simply Arabic *rahj-al ghar*, "powder of the mine." etymology of Crimson [Carmine] and Vermilion obvious, and if the two words were not absol doublets, as Carmine and Crimson are, they were closely allied. Crimson [and Carmine] the French *cramoisin*, and later French *cramoisi*, Low Latin "cramoisinus" and "carmesinus," is fr the Arabic and Persian *kirmisi*, a loan word fi the Sanskrit *krimija*, literally "worm [*kri* engendered." Vermilion is from the Latin "verm lus," diminutive of "vermis," "a worm." But now said that while Kermes, Crimson, and Carmine back to the Sanskrit *krimi*, from which have also cc down to us, through the Sanskrit *chakra* "a whe such words as cycle, circus, wheel, &c., all c veying the idea of evolute turning [cf.: "chucl out"!], Vermilion goes back through the L "vermis," to the Sanskrit *urmis* "a wave," f which have also come down to us such words, all con ing the idea of involute turning, or being coile themselves, as worm, vermin, vermicelli, volu vault, and waltz. However, on the face of it *u* and *krimi* are related, and if Vermilion and Crin are not direct, they are at least collateral "double

Vermilion is still largely manufactured in Ch and also at Calcutta, and in smaller quantitie Surat, and, in all these places, in accordance prescriptions which are essentially the same as tl found in "Theophilus the Monk," and other me val writers on the applied arts.

MEETINGS FOR THE ENSUING WEE

MONDAY, APRIL 9...Medical, 11, Chandos-street, W., 8½
Victoria Institute, 8, Adelphi-terrace, W.C., 4½
Rev. F. A. Walker, "Egyptian Chronology."

TUESDAY, APRIL 10...Medical and Chirurgical, 20, Han square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S. p.m. 1. Sir Lowthian Bell, "The Develop of the Manufacture and Use of Rails in Britain." 2. Mr. Thomas Andrews, "The of Steel Rails in Tunnels."
Pharmaceutical, 17, Bloomsbury-square, W.C., 8
Photographic, 12, Hanover-square, W., 8 Mr. Thomas Bedding, "The Municipal Encou ment of Photography."
Colonial, Whitehall-rooms, Whitehall-place, 8 p.m. Sir John C. R. Colomb, "British Def 1800-1900."

WEDNESDAY, APRIL 11...Japan Society, 20, Hanc square, W., 8½ p.m. Mr. Chozo Koike, Glimpse of Japanese Home Life."
Royal Literary Fund, 7, Adelphi-ter., W.C., 3 p
Astronomical, Burlington-house, W., 8 p.m.

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FRIDAY, APRIL 13, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The Council have determined to add to the existing Examinations of the Society an Upper and a Lower grade, and to revive the system carried on from 1876 to 1879 inclusive, of awarding a certificate in Commercial Knowledge to candidates who have passed in a certain specified number of subjects in each grade. This certificate will be additional to the certificates granted for separate subjects. The examination in the Preliminary or Junior grade will be adapted to the attainments of the continuation school pupil, who, after reaching Standard VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. The examination in the Secondary or Intermediate grade will be of the same standard as that of the present examinations of the Society. The examination in the Final or Upper grade will be adapted to the attainments of youths who have gone through a course of two or three years at a higher commercial school, college, or special institution, and are engaged in, or are qualifying for the higher branches of commercial life. Further particulars of the proposed addition to the examination system will be published in due course.

EXHIBITION OF MODERN ILLUSTRATION.

The Science and Art Department have consented, at the request of the Council of the Society of Arts, to organise an Exhibition of Modern Illustration, consisting of specimens of typographic work suitable for book, magazine, and newspaper illustration. Further particulars will be published in due course.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Monday, April 2, 1900; The Right Hon. Lord Strathcona and Mount Royal, G.C.M.G., LL.D., in the chair.

The paper read was—

THE CENTURY IN OUR COLONIES.

By The Rt. Hon. Sir Charles W. Dilke, Bart., M.P.

When I was asked by the Foreign and Colonial Section to lecture on the Colonies in the 19th century, I felt that the subject was a large one for a single short discourse. I was told that I had a fellow-sufferer, and that Sir William Lee-Warner had promised to deal with India in the same way. We talked the matter over, and we thought that it might be best, where one had, of course, to pick and choose, to say something about how, in his case India, and in my case the Colonies, stood a century ago, leaving our hearers to draw the inevitable contrasts from their own fund of information as to the Colonies and India in the present day.

I am, myself, in a further difficulty, for I lectured here, at the desire of the same Section, three years ago, on "The Colonies in the Sixty Years of the Queen's Reign." Although there had been a rapid improvement in the condition of our colonial empire between 1801, at the beginning of the century, and 1837, at the beginning of the reign, yet, except in one matter, this change had not been so startling as might be supposed; and, to some extent—save as regards that one subject—my position here to-day is much the same as my position here three years back. My old friend, Sir Charles Kennedy, chairman of your Section, has suggested that I might vary my topic on this occasion by treating of the development of self-government in colonies during the present century, contrasting the system of administration at the beginning and at the end of the century, and I take note of that suggestion.

A hundred years ago the foundations of our present colonial empire had been laid. Not only did we possess several tropical colonies of plantation, to which we were soon to add great numbers of others through our successes against France, Spain, Holland, and other colony - owning countries, in the Great War,

but—and this is too often forgotten—the foundations of our self-governing colonial empire had been laid, though all but lost. I do not trace these foundations before the century of our self-governing colonial empire of the present day in the feeble beginnings of the colony of New South Wales. It is in America that I place them. We had had, and had lost, "the American colonies;" but in those colonies we had already been forced to follow, not too willingly, but with excellent effect upon our national mind, that plan of government which has in the second half of the century been taken up again with so much effect, and has given us the eleven self-governing colonies of the present day—the two of South Africa, the two of North America, New Zealand, and the six comprised within Australia and Tasmania, and shortly to be welded together in the Australian Commonwealth. It is often thought, by those who have not read their history, or perused such an excellent compendium as my friend, Mr. Egerton's "Colonial Policy," that we lost "America" because we had set up and maintained there a somewhat despotic system of government, which was opposed to the whole tone of thought of the American people, and which naturally went by the board when they became strong enough. Nothing can be further from the truth. Not very willingly, as I have already said, George II., and even in his earliest years George III., had governed the American colonies under a system of long-standing, by which almost all the officials were chosen by the colonies themselves. There was self-government in, for the times, a remarkable degree, and the final split, when it came, came it may almost be said, upon a detail. George III. intended, however, to have his own way in America, and by that intention contributed to our loss. Still, in the main, what I have said is true, as every reader of Mr. Egerton knows.

Of the North American colonies, Bermuda, which was settled in 1609, had had representative institutions from the first, and a Constitution, based on that of Virginia, from 1620. Virginia had received her third Constitution in the previous year, 1619; and that Constitution, which was to some extent taken as a model in Bermuda, and also followed in others of the North American colonies, is worth a moment's consideration. It was the entrance on the experimental stage of representative government in connection with colonies, which was to be prolific of Constitutions, up to the separation between the mainland colonies and the Crown, and, even after separation, Canada (the late French colony), which their place within the Empire. By Virginian Constitution of 1619, in which s members of the party opposed to the Stu in the House of Commons had a hand, t was a wide suffrage, a fair distributio seats, and a single House; but the government was not complete, for all t action was subject to the Council of Di tors in London. The charter, however, soon revoked, and in 1623 the House Burgesses asserted without protest its clusive claim to levy internal taxation (W ward). About the same date the Englanders were electing their own Go nors, and a "Court" which was in fac tiny Parliament. Local self-government the township was far more highly develo in New England at this time under Stuarts than it was in the Australian colo for many years after they received full pov of responsible government in the latter ha the present century. Pennsylvania had f very early days had a Council and Assembly, both elected by the people, though the former—presided over by Governor (who was in fact Penn, the prietor, or his successor or nominee)— the executive of the colony. The Assem was elected by ballot, and dealt with taxes and the Bills submitted by the Cour Carolina in the Southern States was not behind. In 1719, on the question of extension of local self-government, the colo Assembly quarrelled with the proprietors the colony, and were strong enough to u them and set up a self-governing col directly under the Crown. The Bri colonies of North America, indeed, went m further than merely to obtain self-governm They all but accomplished federation l before the present century, of which it is o thought, within the empire, to be the duct. The West Indies in 1689 produ a temporary federation of the Leeward gro In 1754, under pressure from the mot country, the North American colonies of mainland sent delegates to Albany to colonial congress, and Franklin there ur a federation of the thirteen colonies for fence: a thing which, as yet, we have even in Australasia obtained. Frankl federation failed, not being popular eit with the colonies or with the Crown. idea, however, was but a century-and-a-l before its time.

We have lately seen the British Govern-ent contending, some say with too little ıtience, some say with too much patience, r an extension of franchise in a Republic ıder our paramountcy in South Africa. In e last century a British Government con-nded also for an extension of the franchise the equally stubborn Commonwealth of assachusetts. There was a time when that lony (or State, as it called itself) obsti-ıtely refused to confer the franchise upon ıy but "church members," after having in e previous century limited the franchise to e Independents, who were only a sixth of e population. Massachusetts had the same fection for life-long members of certain ıurches, possessing the full confidence of eir associates, which President Kruger had r burghers who had fought in certain ıttles which the Transvaal Constitution ımed. The British Government after inter-inable negotiation succeeded in obtaining e franchise for the outsiders of the churches, ıo were the Outlanders of New England.

The United Empire Loyalists, the American ories who fled to Canada in great numbers, ough they had taken arms and suffered loss goods and severe pains of every kind for the ke of the Imperial connection, were, never-eless, many of them (as is well shown in orenzo Sabine's "The American Loyalists") ends of legitimate self-government, and, ıat is more important, were used to the actice of self-governing institutions. These ey naturally introduced with them into Upper ınada; and there has never been a time when Canada the practice of self-government, as ıown in the American colonies of Great itain, has died out. For a while the natural ınging of the French inhabitants of Lower ınada, not to their old country, in which they d lost all interest, but to their religion and their tongue, and the, in the times, excusable, cause not unnatural, desire of the English d Scotch to get rid quietly of the French ngue, and even of the predominance of the ench religion, produced conflicts and threw fficulties in the way of self-government. ıe famous Papineau, who led the French-ınadian rebellion in the present century, was Speaker, and the fact in itself ought to mind us that even among the French in ıat is now the Canadian Dominion, con-itutional self-government under the British own goes back a very long way indeed.

The pilgrims of the *Mayflower*, much they may have disliked the English Government of their day, took English law and English principles of self-government across the Atlantic with them. There they have been nurtured and preserved; there in British colonies they have never become extinct; and thence has come the impulse which has extended beneficent principles to our great colonies in the southern seas.

It may have been noticed by my hearers that, in comparing my present subject with my subject of three years ago, I said that the difference between the 60 years' period and the 100 years' period lay mainly in one point, which I did not name. It was slavery. The foundation of the social system of the British tropical colonies a hundred years ago was slavery and the slave trade; and, at the begin-ning of the Queen's reign, slavery and the slave trade were vanishing. The slave trade, in the old sense, is extinct, except for the supply of a few Mohammedan communities. But I am sorry to say that slavery under other names is reviving in our time; and reviving in Africa under conditions which contrast un-favourably, in my belief, with those prevailing in British colonies in the early portion of the century, and which our grandfathers made, nevertheless, heroic efforts to put an end to, as they thought, for ever.

Although a hundred years ago matters were as I have described them, very soon after-wards, long before the conclusion of the Great War—indeed, at its height—in 1807, Parlia-ment made the slave trade illegal. The abolitionists had so completely explained its horrors to the people that the constituencies were determined to put it down. In 1811 the slave trade was made a felony, and in 1821 piracy. But when in 1807 the slave trade was first made illegal, there was no intention to abolish slavery.

While, however, the abolition of slavery was supposed to lie outside practical politics, an immense deal was being done for the ameliora-tion of the condition of the slaves. The laws passed early in the century by our tropical colonies are full of provisions for their comfort. Their Sundays were preserved to them. Holidays were given to them in addition to Sundays. Their hours of labour were regulated on other days. Land had to be supplied to them for gardens, or else wages had to be paid. Sufficient clothing had to be given to them. They had to be maintained in sickness and old age. Their persons were protected against cruelty. They were given

the right to own property, and to hold it against their masters. Protectors of slaves were instituted in the colonies; they were, in fact, inspectors, visiting each place where slaves were kept. No punishment of any kind could be inflicted without being recorded. Every record was inspected by the Protector of Slaves. The law prevented that separation of husband and wife and parent and child which was the opprobrium of slavery in the Southern plantations of America.

It was frequently alleged by the Abolition party in Parliament that there was much prevalence of cruelty in connection with slavery even in the British colonies. But there can be no doubt whatever that in the British West Indian colonies white men were continually imprisoned and frequently hanged for acts of violence against slaves, the sentences of the law being carried out with an impartiality which could not, I fear, be met with either in India or in British South Africa now. Good evidence as to the position of the negroes, at all events in one colony, is afforded by the fact that in Bermuda, at least, negroes served in the colonial militia. (Lucas.)

Emancipation was proclaimed in 1833. It converted in 1834 all slaves in the British Empire into apprenticed labourers. Abolition became complete in 1838; and £20,000,000 was paid as compensation to slave-owners for over 600,000 slaves freed in the British Empire. May we, the descendants of the men who made the law and made the sacrifice, insist that slavery shall not be allowed to creep in again under other names!

In dealing with slavery I have mentioned our old colonies in the West Indies, tropical colonies, which lived with us through the great war. Most of our other tropical colonies were, as I have said, conquered during the great war, as were, indeed, some of the West Indies; and some which we conquered, and which were among the best, like Java, we gave back. India is outside my subject, and some of our settlements in and near the Malay Peninsula, were prize of the great war. There lie, however, between India and Singapore some colonies which have been ours since long before the great war, which became Indian and were part of India for a long time, and then were made colonies again. Colonies in that part of the world have a way of passing through stages of the kind: Labuan, for example, which was a Crown colony, is now administered by a chartered company. But Penang went through the opposite experience. It first belonged, in 1785, to a British subje who married a black lady, a king's daught and who received the island as a marria portion, just as a British king who marr another lady, also a king's daughter, less th half black, received another great tropi settlement as a marriage portion. Capt. Light handed over Penang to the East In Company, and before the present century Company had added Province Wellesley, the mainland, to the island of Penang. M of our settlements in that part of the wo went through a similar history to that of t Cape of Good Hope. They were taken by from the Dutch when Holland had been ov run by France. They were restored to t Dutch at the Peace of Amiens, made with t First Consul in 1801, and taken again in t great war against Napoleon, some of th being restored in 1815, and others n Malacca, however, was obtained back by (after having been ceded to Holland in 18 in 1825, together with a Dutch fort—ev nearer to Calcutta than is now the Fren colony of Chandernagore—in exchange for establishments on the great island of Sumat the future home probably of the tobacco trad Singapore, the most successful of all establishments in the Malay Peninsula, w an invention of our own. We squatted th after the great war, there being nothing, a made it what it is; just as, far later again, made Hong-Kong.

Of our tropical colonies, the most intere ing, and perhaps the most valuable, Ceyl —which, however, is only technically not part of the Indian Empire—was already ou at the beginning of the century, for unli many of the others which had been conquer by us in the early part of the great war, was not restored at the Peace of Amier Ceylon and Trinidad were possessions whi were retained. The French West Indi Islands were given back, and Guiana a the Cape of Good Hope were given back Holland in 1801-2, though afterwards captured. Minorca was given back to Spai Port Mahon (though it is a digression) is t finest port in the Mediterranean which could hold. It has been over and over aga taken by us, frequently long held by us, a over and over again restored. Spain has no it is to be hoped, entered upon an era of peac and to be hoped for her sake, for in the prese temper of the British public the probability that if we ever go to Port Mahon again it m be to stay.

The Cape, as I have said, though it had en taken from the Dutch in 1795, was a re military pledge in 1800, and was restored the Peace of Amiens, and only taken again 1806; and of our present self-governing onies, those of Australia, Canada, and wfoundland alone are to be considered as ving been with us in 1801, for New Zealand s populated in those days only by Maoris, d the pigs of Captain Cook.

Newfoundland is the oldest, or almost the lest of British colonies. It had been finally nquered long before a century ago, and it is ly the unfortunate good nature of our cestors, who were always giving back again peace the things which they had won in r, and creating for us difficulties which they ght have foreseen, which still burdens us in wfoundland with a trace of what was once puted ownership. The French shore difficulty tes from the Treaty of Utrecht, now nearly a uple of centuries ago, although the Shore itself it is in question has moved since that time, d the nature of the fishery has wholly altered. e present dispute indeed is about lobster-nning; a question which has only arisen in last few years, for lobster-canning was heard of in earlier days; but you will not pect me here to-night to go into this long-nding dispute with France, although there oo much reason to fear that unless prudently tled now, as it easily might be, it will one y produce great harm. Apart from this tressing and dangerous question, New-ndland may be neglected as comparatively important in our story; and I cannot do ter than spend the rest of the time which is my disposal in considering with you what s the state of things in Australia and Canada undred years ago, and leave you to draw in ur minds the necessary moral which the ntrast with the existing state of things nveys.

Australia in 1801 was a new settlement; a nvict settlement in its early days. Happily, w the swarming population of strong, adven-ous men drawn to it by the gold rushes, and ained by agriculture, has swamped the nvict element, which, so far as it consisted men sunk in crime, was not prolific.

The original Australian colony was New uth Wales, out of which Tasmania, Victoria, d Queensland were successively carved; estern Australia, South Australia, and then, ross the seas, New Zealand being sepa-ely settled later. It may astonish hearers be told of the island of Tasmania being carved by man out of the territory of New South Wales, but originally Tasmania was supposed to be part of the mainland, and although the contrary was known long before New South Wales was created by proclamation, yet the boundaries were wide which were given to the colony, and included a large portion of the South Seas.

The history of the Colonies in the present century has been largely the history of the development of free institutions under democratic government in Australia and New Zealand. But that part of the subject concerns mainly the change in the Queen's reign rather than the change between 1800 and 1900, and was, therefore, my subject in the previous paper to which allusion has been made.

The birth of the Canadian Dominion was of a different kind, and much more complex. I have already told how the Loyalists of the American colonies swarmed across the frontier, or, after coming to England, as many of them did from the Southern States, recrossed the Atlantic to found homes in Upper Canada. The French element in Lower Canada, on the other hand, had been conquered; conquered largely by the efforts of American militia officers, like Washington himself, and of the American militiamen from the colonies which afterwards revolted; but accidental circumstances tended to make Canada loyal and tolerably content within a very few years indeed of its first conquest. To begin with, the French Canadians disliked the American colonists (with whom they had constantly throughout their history been fighting) a great deal more than they did that to them, at that time, harmless abstraction "the King of England." Then the French Canadians had not been happy in their relations with their own mother country. They were steady even through the severe trials of the American War, when we were fighting both our revolted colonies and also France. The French Revolution afterwards profoundly shook their sentiments, which in those days were far more Catholic and monarchic than they were nationally French. This is a matter not easy for us to understand. We have lived through the full height of the nationality period. But, except in Poland, it was a movement which began after the Revolution. For the masses of the people there was little idea of French nationality before 1789, and as soon as the idea of a French nation, apart from the person of the king, sprang up in the minds of the French Canadians, it was found by them a

hobgoblin, of which their fright was such as to drive them more towards ourselves. The French sentiment of Canada, not very deep in the sense of affecting political action, is based upon language and literature, and is a sentiment of our day. There was not a single printing-press in Canada at the time of the British conquest. The first newspapers came with British rule; and a loyalty immediately after the conquest, which we can hardly now at first sight explain, is not inexplicable when circumstances are considered. The Americans counted on the French Canadians siding with them. In those days Roman Catholics were excluded from our colonial assemblies; and we had declined to place the government of French Canada in the hands of an Assembly which would have excluded the Roman Catholics, and had left it under a Governor in Council, continued from the French days—a system which included the French Catholics within the Government. The clergy stood firm, through the American rebellion, for British rule; and, although most of the country people remained neutral in the war, yet a large number of French - Canadian volunteers joined the British arms to fight against their old enemies represented by the American Congress. Local patriotism, rather than a feeling of French *versus* British entered mainly into account, and the local determination was that Boston should not hold Quebec or Montreal.

A curious fact in connection with this strange loyalty of Canada to us in the early days after the conquest is that some of the Red Indians who had carried on the war against us to the last, and had fought as late as 1763, when there were no Frenchmen fighting, were among the United Empire Loyalists who crossed the frontier rather than become independent American. Other Indians had fought on our side in both wars. The Mohawk nation came in as a whole, and received lands as supporters of the British Crown. The Iroquois and other Indians, after being armed by the French against us, had, as is well known from the declamation of Pitt, Fox, and Burke, in their opposition to the American War, been employed by ourselves against the American colonists. They did not, however, join either the French in the first instance, or ourselves in the second, for sordid love of gain. They were legitimate supporters, in the first instance, of the French Crown up to 1763, and then of the British Crown up to the Treaty of
Versailles, and for the same reason for whi
the French *habitants* took this same cour
namely, their constant historical opposition
and warfare against the colonists of t
American colonies — the Yankees or Bost
men.

Kingston and the settlements near Niag
were founded by the Loyalists just before t
French Revolution. Slavery was virtua
abolished in Canada at the end of t
century with a view of tempting-in t
labour of the runaway slaves from t
United States, who rapidly increased
Canada, and by the beginning of the cent
Canada was fairly settled along the lines of t
rivers and lakes, up to or beyond Toronto. S
fought hard for us in the war of 1812. T
French-Canadian volunteers fought side
side with the United Empire Loyalists agai
the United States, and Canada emerged
nation from that war at the beginning of 18
The only set-back was produced by Gove
mental reaction in the high Tory days whi
preceded the great Reform Bill here, wh
there was trouble with the reformers among t
Scotchmen in Upper Canada, and afterwa
among the French in the province of Queb
The friends of the Honourable Louis Papine
Speaker of the House of Assembly, who, a
have said, rose in insurrection, beat us once
1837, but, like the Irish insurgents of the ca
bage-garden skirmish, they went home a
nothing happened. The priests had sto
firmly loyal. Lord Durham was sent out a
told the truth in his report, and reform w
gradually reintroduced.

The grievances must have been great whi
took into the field a gentleman who for ma
years had enjoyed a salary (in those days a
for such a country large) of £900 a year
Speaker of the House of Assembly. Whet
his influence was sufficient to persuade t
clerk, the assistant-clerk, the English tra
lator, the French translator, and the law cl
at the table of the House of Assembly, and t
Sergeant-at-Arms, to accompany him, w
the mace, history, so far as I know, does
say. But Papineau has always borne a hi
reputation; and, although I put it laughing
we all must feel that the grievance of t
French must have been considerable, wh
after the loyalty that they had shown to t
British connection through two wars, t
Speaker of their House of Assembly actua
headed an armed rising. It is, perha
worthy of notice that, while the leader of
surgents in Lower Canada was a Speaker,

[th]e early days of Victoria, a leader of insur[gen]ts, who lost an arm, afterwards became a [Spe]aker.

[M]y point has been that British self-govern[me]nt in the great colonies is not an invention, [as] is often now thought, of our own times, of [the] second half of the century, or even of the [Qu]een's reign, but that, born in the West [Ind]ies and the American colonies, it survived [in] Canada. Papineau's rebellion was a rebel[lio]n not against the state of things which had [exi]sted always before his day, but against a [cha]nge for the worse which had been intro[du]ced in the present century, as I have put it, [by] reaction. As long ago as 1791, the French [of] Lower Canada had a Privy Council under [the] Crown, and a representative assembly con[sis]ting of 8 citizens, 3 burgesses, and 39 [kni]ghts of the shire. The distribution of seats [wa]s far from perfect, but it was at least infinitely [mo]re in accordance with population than that [wh]ich prevailed in England in 1831 or in 1884, [an]d indeed almost exactly the same as, or [ver]y slightly superior to, that which prevails in [En]gland now. The King of England was, [alr]eady in the last century, the ruler in Canada [as] a limited monarchy, supreme authority being [in] the Imperial Parliament, but as limited by the [Ca]pitulations of the Province of Canada. No [tax]es, for instance, could be imposed, except [to] be applied with the advice and consent of [the] Legislative Council and Assembly of the [Pr]ovince; and this by Imperial legislation of [th]e last century. The franchises existing in [Ca]nada in the last century, as amended and [ref]ormed by Mr. Pitt, were as wide as those [est]ablished in the mother country by the [Re]form Act of 1832. In addition to a 40s. [fre]ehold franchise, there was a £10 rental [fra]nchise, and an absolute freedom as regarded [rel]igious disabilities in the electorate. Pay[me]nt of members did not exist at the beginning [of] the century, but was introduced in Canada [be]fore the Reform Bill was introduced in the [mo]ther country. It will be seen where Mr. [W]entworth and his friends in New South [W]ales found precedent for asking for the [ea]rliest Australian Constitution, and where the [Co]lonial Office found precedent for granting it. [I l]ook rather to this Canadian precedent, tried [lar]gely and generously by Pitt, under circum[sta]nces of great difficulty, than to such prece[de]nts as those of Bahamas, Jamaica, &c., [wh]ere there were, as I have shown, Assemblies, [bu]t Assemblies representing mainly the land[ow]ning or capitalist class. The Constitutions [of] Pennsylvania, Virginia, Carolina, and others of the mainland plantations were, however, more probably in Pitt's mind. Pitt took power to himself in 1791 to create a Canadian House of Lords; but did not exercise it. The Seigneurs would have been too intensely Catholic, and it would have been too unpopular to pass them over, and create outsiders (over their heads) Canadian Peers. We have now at least two distinguished Canadian peers; but they are peers of the United Kingdom, and not French Canadians, but Scotchmen.

I have mentioned again the Assemblies of Bahamas and Jamaica. Jamaica had so elaborate a Parliament that it even professed to have adopted the Bauble which Cromwell took away. Speaker Peel is said on one occasion to have told his then constituents that the old Parliamentary mace (our own dating from the Restoration) was the mace of the Parliament of Jamaica up to the time when that Parliament was abolished. I think that this has been shown to have been probably an error. But there can be no doubt as to the dignity, as well as the antiquity, of some of the West Indian Parliaments. Sir Charles Kennedy, you will remember, suggested to me that I should take as my theme to-day the development of self-government in the Colonies during the 19th century, and contrast the system of administration at the beginning of the century and at its end. Unfortunately, in the West Indies, the change has been exactly in the opposite direction from the general line of advance, as indicated, for example, in New South Wales—advance from a despotic administration by a soldier or a naval officer, not always of the best of tempers, to an almost too "free" democratic community which boasts the *Sydney Bulletin*. In the West Indies, outside Jamaica, Parliamentary Government had its wings clipped many years ago; and, although no two islands now possess exactly the same Constitution, none of them has that extent of representative institutions which at one time nearly all enjoyed. Under slavery the West Indian colonies were Parliamentary oligarchies. Under emancipation and freedom, the negroes in many of them came to the front, and increased in numbers and in wealth, and swamped, or threatened to swamp, the whites. Ever since 1848 the French in their colonies of Martinique and Guadeloupe have accepted the situation. They have manhood suffrage. There is an overwhelming negro majority. The negroes are led by the so-called coloured people; that is, the clever half-castes. The French colonies return

senators and deputies to the French Parliament. They elect *conseils-généraux*, which have all the powers of the council of a French department, and a great many others too. Our Colonial Office and our white colonists of the West Indies are opposed to the French system, and various devices are adopted for preventing majority rule. In the last century the colonial legislatures of the West Indies, though without the modern British Cabinet system, had claimed in other respects powers greater than those which even the Dominion, or New Zealand, or the Australian colonies, exercise at the present moment. They insisted on their absolute legal right to approach the Home Government independently of their Governors. The Board of Trade, on the other hand, insisted that such a course could not be allowed except where complaint was made by the colony of the personal conduct of the Governor, and that in other cases (as Mr. Egerton puts it) "the Governor must be the conduit pipe through which the colonies should approach the Home Government." Jamaica and Barbados fought hard against even this restriction. Jamaica had had its earlier constitutional struggles. Charles II. had given the freest institutions to Jamaica, but, before the Stuarts were driven from the throne, the attempt to apply to Jamaica the legislative system which had been introduced into Ireland, all but led to a revolt. In 1680 the Crown gave way, but no final settlement was come to till 1728, when the whole body of the island laws were confirmed by the Crown (Lucas). Between 1855 and 1866, Jamaica advanced, indeed, still further along the path of freedom; but what the Stuarts failed to accomplish in Jamaica has now, under altered circumstances, been brought about in our time, partly some years ago, and completely within the last few months. Other demands by the West Indian colonies required the intervention of a Select Committee of the House of Commons, which thought them "illegal . . . . and derogatory to the rights of the Crown and people of Great Britain." They had objected in fact to that practice of occasionally reserving Bills for the Royal assent at home, with the chance of veto, which is still found necessary even in the case of our greatest colonies. Jamaica, the most strenuous asserter of colonial rights, was a colony, it will be remembered, conquered by Cromwell from a foreign power, without any previous representative Government. In the case of Jamaica treaties were silent as to her constitutional rights. We are slaves of our treaty-word, in the case of British Guiana we have preser up to the present time a most amazing pol simply because it was guaranteed by us w we acquired the territory from the Dut Up to the present reign the constitution Jamaica was more liberal in some import points than that now existing in any s governing colony, or even at home. example, it was not necessary in Jamaica t grants of money should be recommended b representative of the Crown; and the Assem had handed over large powers to certain of members as commissioners, whose pow continued notwithstanding a dissolution of Assembly, and so rendered nugatory the po of the Crown or Governor to dissolve. was not till the time of many of us h present that the first great change of Jamaica constitution was adopted. The n change in Jamaica involved the compl abolition of the Constitution. After the ri of 1865 the Jamaica Legislature brought it to an end in 1866. What in the way of f government was reconstituted has now ag gone by the board.

As I have referred to the conquest Jamaica, it is perhaps worth noting, in th days when we are receiving volunteers fr Canada for fighting in South Africa, as received volunteers from the American colon (Washington himself included) for fighting Canada, that far earlier, namely under Cro well in 1655, the colony of Barbados sent 3,5 men of her own to fight for us against t Spaniards in Jamaica.

In trying then, to adopt Sir Charles Kenned suggestion, we have to note great divergenc of practice within the Empire and in differe portions of the British world. In Newfoundla self-government has continued, and undergo but slight change in taking its present for In the rest of British North America there w reaction early in the century; and developme upon admirable federal lines, bringing togeth the tongues, the races, and the religions, our own day. In South Africa the mode form of representative and responsible i stitutions has been introduced into Ca Colony and Natal, with a foundation of Dut institutions in Cape Colony, and of Dutc Roman law. For instance, there exists Cape Colony the universal liability to arms, the form of field-cornet and commando, whi exists in this shape in no other colony. In t Channel Islands (which are not colonies, b which claim that we are their colony inasmu

they belong to the Queen of England as ıchess of Normandy—her older title), there universal liability to arms, but of the feudal ɔe. In Australasia we have seen developnt; from savagery in New Zealand, and from ocratic rule on the Australian continent into modern colonial system of responsible and resentative government, completed by the ınt of a constitution to Western Australia in)o. In the West Indies we have seen the andonment of constitutional government for ious forms of Crown Colony system. In ny other other parts of the Empire there has n little change, the power being mainly in hands of Governors sent out from home—vised by local personages, in some cases minated, in some cases representative, but ble.

The present form of responsible government s introduced into Upper and Lower Canada 1840; in the various colonies of Australia cept Western Australia), and in New aland, between 1840 and 1855, but chiefly in 5, in which year Newfoundland also eived government of the modern type; in 2, to the Cape; and in very recent times Natal and Western Australia. The nadian Government became in the meane more highly developed by the federation all the North American colonies (except wfoundland) in the Dominion; and Canada self is in some matters now about to be sursed by the creation of the Australian nmonwealth.

All these various things have been done or undone without much system. We are not ple of system. The Republican Provisional vernment of France of 1848, and the Government of National Defence of 1870, both of them ung from revolutionary or mob origin, and n no legal basis of existence, at a stroke of pen introduced the most far-reaching nges of system to the French colonies, ch have continued in both cases to the sent day. The revolutionary action of 1848 he French colonies lasted through and surd the Second Empire. With us, we have tered along, developing the most admirable itutions of the most advanced and demotic description, but with the most complete cess, in the greater portion of our ninions; and in other parts have pottered the opposite direction, maintaining or reoducing despotic rule, not always of the st intelligent type. But, such is the adaptay of our race that we have generally been ified by a fair measure of practical success.

At the beginning of the century we were fighting for existence, much more concerned with defending our colonies, or taking away the colonies of other people, than with developing the dominions of the Crown. We made, indeed, a bold attempt, early in the century, to capture South America, and sweep away the whole of the Spanish colonies at a blow, Spain having become the prey of anarchy through the action of Napoleon. He, on his side, tried to make South America French. Both failed. He, because he never possessed that command of the sea which was necessary for his operation; we, because, although we could reach South America, when we did reach it, did so with insufficient forces which on two occasions suffered severe defeat with circumstances of capitulation which led to military enquiries and trials by court martial. The foundations of the British Empire, as we know it now, were laid in the days of Elizabeth and by Cromwell. They were nurtured by the blood of our people and by the successes of our fleet in the days of Chatham. But the actual result in territory at the beginning of the century had been small. Australia, like India, may be said even at that time to have been potentially ours. But we held only spots upon the coast of India, and in Australia only the coast of what is now New South Wales. The Pacific Coast side of Canada and of the United States had not been parted; and Mexico, succeeding to Spain, early in the century began to claim the whole. We agreed with the Americans not to allow the Spanish missions among the Indians to shut the American door and our door to the Pacific. We finally compromised, and divided.

The most interesting considerations of the speculative type which are now connected with the British Empire turn upon the future in the Pacific. Australia, but for the alarming decline in its birth-rate, which has reduced the birth-rate in its southern colonies to that of France, ought to play a great part in the future of the Pacific, and to be seconded in that part by Canada. The United States—happily united again with us in the bonds of friendship—is vying with us in establishing the influence of English speech and English law throughout the islands, and on the coasts of China. Germany is a new comer in the Pacific. But the future of that ocean, in the first instance, lies in the relations of our Colonies and of the United States to Germany and Japan, and, in the long run, in the relations of our Colonies and the United States

with Russia. The confederation of Australia in the Commonwealth will rapidly advance her action in the Pacific.

I have alluded to the Commonwealth Constitution as more advanced in some respects than even that of the Dominion. Canada has a nominated Senate. The Senate of the Commonwealth is to be elected by the States, like that of the United States. There being the Cabinet system, combined with membership of the Houses by members of the Cabinet, which does not prevail in the United States, and it being yet doubtful which will be the more democratic and which the more powerful of the two Houses, provision has been made in the Australian Constitution for deadlock between the Houses.

The only important conflict which may arise in Parliament here, over the provisions of the Commonwealth Constitution, concerns the provisions for appeal to the Privy Council. It is not, however, essential that the Bill should be modified upon this point in order to keep the Privy Council as the ultimate Court of Appeal for the Empire. The Commonwealth Constitution provides that the appeal so far as it continues may be modified by federal legislation; and in assenting to this proposal, if he does so, the Secretary of State may say that he is glad to learn that it is not intended by the authors of the proposal to further restrict appeals to the Privy Council, and that any such legislation in the future would not, as a matter of course, be certain to receive the Queen's assent. In the Federal Convention, the divisions upon the subject were very close, and it is probable that there would be no desire to push things to an extreme.

If any moral is to be drawn from this paper as a whole, it is perhaps one in favour of providing in time of peace (whenever peace shall come) for regularising the use of the power of the Empire in time of war. It is no doubt the case that any rashness is to be deprecated, and that we lost the American colonies by an ill-directed attempt to try to do this very thing. We have, however, learnt much in the meantime, and proposals which would be made now would be joint proposals, and would be forwarded by diplomacy of a more tactful kind.

DISCUSSION.

The CHAIRMAN said that this admirable address had been of great interest, as everyone might have expected. They all knew that Sir Charles Dilke had given as much attention to the colonial em as perhaps any other man in Great Britain. T had from him, many years ago, an instructive b entitled, "Greater Britain," from which they gained a great deal of valuable information. those days there were opportunists who thou that the colonies, instead of being a help to mother country, were a hindrance, and that would be a great advantage to Great Britain to entirely rid of them; but, happily, he believed such feeling had ceased to exist. In his paper, Charles had gone back a hundred years, and tra the enormous development of the colonial emp The word "Colony" was used for want of a be term, but he considered that "Empire" was the ri word now. The colonies had got beyond the of tutelage, and stood together as one with mother country. The result of the developmen self-government was to be seen in the federatior Canada, and any one who had studied the sub must feel that it was a very great advance to have Dominion of Canada, instead of the several provir of which it was composed each acting for itself. T confederation tended greatly to add to the we and strength of the Empire, and another ef of the growth of self-government was to be s in the colonies coming forward to help the mot country as they had recently done. Was it no grand thing to find the soldiers of the Queen fr Australasia, from Canada, from Africa, from In and Ceylon, all fighting side by side with those of mother country? They were fighting for a princi The war had been thrust upon Great Britain; her colonies, which had self-government, and that their constitutions gave equal liberty to were determined, so far as in them lay, that t would assist the mother country in giving the sa beneficent government to the whole of South Afr With less than that none would be contented, such a decision would lead to a still closer unity the different parts of the Empire. There had be perhaps, greater difficulty in the way of the federat of the great provinces of Canada than there would in Australia and South Africa; of course it might said that the republics would not be willing to co into union with the colonies, but they would s find that in every respect they would have more libe and more true justice meted out to them than t had yet enjoyed. He was glad to note that Austr was within a very short distance of becoming commonwealth. Sir Charles had told them t perhaps that commonwealth might have some adv tage over the Dominion of Canada. He might that Canadians were very well pleased with w they had, and would be quite satisfied if the efforts their friends in Australia were attended with eq success.

The Hon. JOSEPH ISRAEL TARTE (Minister Public Works in Canada) said it was hardly fair call upon him to speak without any preparation,

[h]e owed a debt of gratitude to Sir Charles Dilke [for] the instruction he had derived from his writings, [he w]ould not hesitate. In a speech made a few weeks [ago] in the Canadian House of Commons, he ex[pres]sed his obligation to the Right Hon. Baronet for [wha]t he had said and written about Canada, with [spec]ial reference to Her Majesty's loyal subjects, the [Fre]nch-Canadians. In his last work, "The British [Em]pire," Sir Charles Dilke resumed, in a few words, [the] position of the French-Canadians:—"Intensely [Fre]nch they were," he said, "but, at the same time, [inte]nsely British." There was no English public [man] who had understood French-Canadians so well. [The]y were French because their fathers and mothers [wer]e French, but they were British to the core, just [as m]uch British as French. It was the glory of [Brit]ish institutions to have captured their loyalty. [The]y had had difficulties to cope with, including [rebe]llions, in which the French were not the [only] people who took part. The English were [quit]e as eager for liberty as M. Papineau, and [his] (Mr. Tarte's) own father was a rebel, but [that] did not prevent his being a loyal subject [to-d]ay. They had learned to love British in[stit]utions, and were building on the other side [of t]he ocean a new British empire, and if occasion[ally] they might hear of some little friction they [shou]ld not pay too much attention to that. [Eng]lish and French were both subjects of the [Que]en, and were working harmoniously together [und]er the same institutions and the same flag. [The]y had done what they could to render assist[ance] to the Empire recently, and though England [did] not require material support, Canada had lent [her] moral support. The other day when he was [pres]ent at the reception of the Minister of Foreign [Affa]irs in France he was introduced to the repre[sent]ative of the Transvaal and told him that the [Dut]ch would be defeated, but the result of the [war] was clear. He told them also that he wished [that] the Dutch element would do what the French-[Can]adians had done, come under British rule and [take] advantage of it. The Canadians had not always [been] highly pleased with English rule because mili[tary] government was first established in Canada, and [they] did not like it—nobody would; but since then [Brit]ish statesmen had learned a good deal, and nobody [had] any doubt whatever that when peace was estab[lish]ed in South Africa the greatest freedom would [be g]iven to all the inhabitants of the country whether [Dut]ch, English, or French. He wished them the [sam]e freedom and the same liberty as were enjoyed [in C]anada. They had there two parties, and at times [they] went to the extreme. The French-Canadians [wer]e occasionally accused of being disloyal because [they] did not share English views, but he might [take] that opportunity of assuring the British public [that] they might rely on the French-Canadians as [they] might on the best British citizens of England. [The]y were subjects of the Queen, and they would [like] to be equally citizens of the Empire. If they were to share the burdens of England they should have a voice in the Imperial councils. Here he spoke only for himself, but his views were not new. He had expressed them twelve years ago, and if he was mistaken then it was owing to the teachings of Sir Charles Dilke.

The Hon. ALFRED DEAKIN (Federation delegate) said he took it as a happy augury that on this occasion precedence had been given to the great Dominion. Separated as they were in Victoria by almost the breadth of the planet from Canada, they had turned to that country for constitutional lessons, and he trusted had learned them. The Chairman had spoken words of hopeful appreciation with regard to the measure which was about to be introduced into the Imperial Parliament for the establishment of a union amongst the Australian colonies parallel to that which existed in North America. That was his mission here. The message from Canada eloquently delivered by Mr. Tarte—stirring to Englishmen—was strengthening to Australia. They listened to his tone of comradeship, and although his loyal words appealed more directly to England, yet the loyal attachment he proclaimed was common to the whole of the colonies, and united them. He was there, though a Victorian, representative of Australia, together with his friends, Sir Julian Salomons and Sir John Cockburn, men of longer experience than himself. Still, he was proud to say that in the present delegation to this country there was one novel feature. This was that, though all five came from different colonies, each had been appointed by the whole of the premiers of the group, and each spoke for Australia as a whole. He regretted that he was not in time to hear the paper read. He gathered that Sir Charles Dilke, than whom there was no higher authority on all colonial questions, had made reference to the business which had brought the delegates to London. On that point he might say a few words. Amongst those who claimed to be Imperialists, and who were earnest in their desire to further Imperial development, he found some who appeared to possess no actual knowledge of what the Empire was. It was fortunate that such men had not the administration of the enormous territories of which they knew next to nothing. The British Parliament had sometimes to legislate for them. It was the sovereign body to which the colonies were compelled to appeal, and they had to rely on the sympathy rather than on the knowledge of its members for the welcome they received. The Australian measure shortly to be laid before Parliament stood out on account of special circumstances surrounding its history. It had engaged for many years the attention of the citizens of no inconsiderable portion of the Empire, and had been ratified by the legislative action of their Parliaments at least twice, and by the overwhelming votes of all the citizens on at least two occasions. The measure they now submitted as a Charter of Union, which the Australian people had prepared, was

perhaps singular in English history since the people themselves were its makers. They chose from their own ranks the men who moulded it; they stood at their elbows during the whole process of its evolution. There were no secret sittings, and it was before the eyes of the whole population that their representatives created a constitution which the whole people had now unanimously accepted. This would be laid before the Imperial Legislature as an ordinary Bill, wide-reaching, perhaps, and bold in some of its innovations, but adapted with care as far as possible to local circumstances, and by the help of British, American, Canadian, and Swiss precedents. It had now become something more than an ordinary Act of Parliament, at any rate, to the Australian people. It was their own child, their own nursling, so that it almost might be said to be bone of their bone and flesh of their flesh; they looked upon it with the natural fondness of a parent, and were, perhaps, somewhat blind, even to its defects. What might seem defects to outsiders represented the results of that familiar process of British politics through which, by means of compromise on compromise, they strove to bring common sense and uncommon ideals into unity. They admitted that to the eye of a mere critic these must appear blots; but for their best justification they would point historically to their origin. They were able to forget them when they realised how, at last, after long effort, the best wishes and ambitions of the whole people were centered in this measure. They did not claim the Constitution to be better than anything else which could be devised, but presented it as the best adapted to the Australian people which could now be achieved. It came supported by all sections, even those once opposed to it having now rallied to it and accepted it with heartiness. All set their hopes on its fruition. It was for this reason that he spoke of it with warmth and devotion. It was a charter of liberty of which the Empire might well be proud, bringing together in organic union those whose varying interests had hitherto hampered each other's growth and marred its fulness. It would make them one in thought and one in deed; what that thought and deed were in relation to the Empire he need not stop to say. It had been proved by something more than speech, and was being proved day by day. No one could doubt or question the patriotism of the Australian people. Having shaped the constitution which was now laid before the Imperial Parliament in a spirit of self-reliance and of confidence in the mother country, they might be held not unduly extreme in their demands if they asked Englishmen to remember that to them it represented no inconsiderable section of their history, embodying no inconsiderable portion of their ideals, and with all its imperfections had been framed under circumstances of trial which had deeply endeared it to all who were associated with it, and expected to be affected by it for generations yet to come. It was a whole and should be dealt with only as a whole. They asked for a reception from the sovereign legislature of the British people, w would prove that they were not unmindful of this constitution had cost and what it might prov those who were to live under it and of whose t was the crown.

Sir WILLIAM LEE-WARNER, K.C.S.I., said Sir Charles Dilke had dwelt upon divergences wi the Empire, but the most remarkable divergence between our work in India and Colonial developn during the century. In the paper lately read "Our Work in India in the 19th Century," n was said of our work for the peoples of India the activity of British administration, and aln nothing about work by the peoples or self-governm The contrast was accentuated by the most valu review of the work of the century in the colonies, read. On every page it treated of the developn of self-government, constitutions, representative stitutions, and democratic movements. How wa that a review of the century's work in India wa silent in matters upon which Sir Charles Dilke been so eloquent? Why had the course of Bri empire pursued in two fields such opposite cours Must our countrymen who had ruled India charged with neglect and failure, when our colo empire was so fruitful in results? The explanat was supplied by the paper just read. Sir Cha Dilke had said "My point has been that British s government in the great colonies is not an inventi as is often now thought, of our own times, of second part of the century, or even of the Quee reign, but that born in the West Indies and in American colonies, it survived in Canada." paper just read even showed that in some colo in the West Indies, instead of a development, th had arisen the necessity for clipping the wings Parliamentary government. Now in India th were no representative assemblies, for the assem in Mysore had no powers of taxation or of la making, and the legislative assemblies of provinces were not strictly representative. Bef our rule the people were governed, and govern badly. They nowhere governed themselves. Ca laid its hands on some liberties, and religi bigotry on others. Women had no status. Slav existed, and forced labour was generally recognis So far as any law existed before our rule, there one law for the poor and another for the pries class. Even now, after a century and a half of rule, low castes were kept out of the schools, and principle of equality in the eye of the law was o maintained by the insistence of British rulers. W the masses of India wanted was justice and securi and they knew that these were only safe while t were ruled by the British, and that they would endangered if they were to attempt to govern the selves. The colonies had none of the difficulties India to contend with. They were not split up strong differences of language, of religion, or of cas Freedom and equality were the foundations of th

l life as they were of us in the mother country, their political institutions grew out of their l and religious environment. Whenever Indian ons and society should agree to respect the rights of men and women, then the practical nistrator would no doubt pass on to them some e heavy burden of government; and if, as in the of Jamaica, the present of a bauble would advance ers, no doubt one would be found. As Sir les Dilke had said, we were a "practical" le, and in India we were endeavouring by means cal district boards and of municipalities to find ow far the people could learn to govern them- s. We needed a long course of education and l improvement before it would be safe to much faster than we were going. There only one other matter to which he desired efer. He rejoiced to hear the strong terms vhich Sir Charles Dilke denounced slavery. abolition of it in British India was one of the est events of the century. The odious institu- however, still encircled India. We abolished it Manipur after the disaster in 1891. Colonel nd, in his interesting book on "Making a tier," described its effects on our North- tern border, and some domestic slaves were still found in some native States. But it was gone British India, and contract labourers could not escribed as slaves. [Sir Charles Dilke here ex- ed that he did not refer to labourers in tea estates, o certain trials by jury, and the escape of persons ged with murder.] Sir William Lee-Warner tted that justice had occasionally miscarried, but was not due to any paltering with slavery, or to a g view as to the position and rights of servants failures were generally due to the application of aws of evidence, and to our presumption in favour nocence, applied to a country where perjury was so ent, and where many a good case was ruined by geration and falsehood on the part of witnesses. derers did escape, but they were equally native European, and they escaped because judges and s could not believe all that the witnesses told n. In conclusion, he desired to add his testi- y to that of other speakers as to the deep interest value of the paper. When it appeared in the *rnal* it would be recognised by its readers as a attractive nutshell full of the most suggestive interesting facts on a vast question.

ie Hon. SIR JULIAN SALOMONS, Q.C. (Agent- eral for New South Wales), said he had not had advantage of reading the paper, and would comment upon one or two points. If anyone to draw the conclusion that the proposed eral Bill would have the effect of destroying appeal from the superior Courts of Australia to Privy Council, it would be a serious error. He e from some knowledge of the Bill and some erience in the Courts, and he ventured to say that tever might have been intended by the draughts- man the right of coming from the Supreme Courts in the Australian Colonies if it were an appealable amount to the Privy Council was in no way touched by the Bill. On the question whether there was to be or ought to be an appeal from the Court of Appeal in this colony he would say nothing, because time would not allow of dealing with it. He must say he had been charmed with the able and interesting speech of his friend Mr. Deakin, and he was sure they would all agree both from what he had said and his manner of saying it, that there was no sign of degeneration in the Australian Colonies. He might say that with all the more grace because he admitted that he was opposed to the framework of this particular Bill, and favoured the Canadian model under which the whole powers of Government were centred in the Federal Parliament except those which were given specially to the provincial Governments, whereas this Bill, following the American precedent, gave only limited powers to the Federal Parliament, and left all existing legislative powers in the provincial legislatures. He was not sorry, because now an experiment would be made that, as far as he knew, had no precedent. He spoke after an experience going back before Mr. Deakin was born, for it was something like fifty years since he first went to Australia, and he had not the slightest doubt that with the knowledge, political experience, patriotism, and wisdom of the Australian colonies, the Bill, even if left in its present form, would result in a great success, and fortunately whatever by some might be thought to have been in the past the difficulty of working harmoniously with what was called Downing - street, the Imperial Government had now gone happily towards the other extreme, and they were uniting the Empire, not with a view to the aggrandisement of England, but because every thoughtful man saw that the only hope or possibility of universal peace was in the union of two-thirds of the civilised world, who in time would be able to bring about, by preponderance of political and material force, that impossibility of war, which he feared the late sitting at the Hague was not able to accomplish.

The Hon. Sir JOHN ALEXANDER COCKBURN, K.C.M.G. (Agent-General for South Australia), said he had been glad to hear Sir Julian Salomons remove the impression which obtained in the minds of many people with regard to what was erroneously supposed to be a very far-reaching clause in the Bill alluding to the Privy Council. It was not necessary to add anything to what had been so well and bravely said by Mr. Deakin, nor did he feel inclined to say anything. They had been sitting at the feet of a master that afternoon, listening to the words of a man whom Australians recognised as the one above all others qualified by a lifelong study to speak on questions relating to the colonies, and having listened to such an address he felt more inclined to go away and think over it than to speak.

It had given him the greatest satisfaction to find that Sir Charles Dilke laid emphasis on the fact that the genius of the British Empire lay in the capacity of the British people for local self-government. He had pointed out that where this genius had had its full scope success had followed, and where it had been thwarted misfortunes had ensued. The history of the century might be almost called the history of the British Colonies. When they considered what London was only a few years ago, when he was a student at college, and what it was now, they could not but recognise that the great extension of the metropolis had been coincident with, and in no small measure dependent upon, the development of the British Colonies: the power given them to manage their own affairs had led to the enormous widening and strengthening of the whole Empire. They had seen during the course of this century the Colonies raised from a point almost of reprobation up to their present standard. They had been exalted from receptacles of rubbish into temples fitted for the habitation of the best traditions of the Imperial spirit. They had risen by a process of evolution to their present dignity and helpfulness, as had been realised on all sides during the past few months.

The CHAIRMAN then proposed a hearty vote of thanks to Sir Charles Dilke, which was carried unanimously.

The Right Hon. Sir CHARLES DILKE, Bart., M.P., in reply, said he regretted if anything in his paper had led to a misconception with regard to appeals to the Privy Council. He had simply, however, set forth the facts. The Chairman in his opening remarks had made an interesting reference to the general principles of federation and to the difficulties which arose in Canada and to the way in which those difficulties were overcome, and those remarks were illustrated by the speech of Mr. Tarte. He might suggest that the case of Switzerland was an amazing one to show what difficulties could, in fact, be smoothed over by local federation. In Switzerland, Cantons had to make official proclamations in the various German, Italian, and French languages. There were two great races, and two religions held in the most fiercely opposite ways. There was the Protestantism of the French Cantons, and the Catholicism of the Italian and German, and these religious differences were so deep that they had led to actual civil war, and yet under the sway of federal ideas at the present time a united central government had been formed and all these difficulties had disappeared. Great as were the difficulties in the case of Canada, they were not so great as in the case of Switzerland, but in each case they had been entirely removed. Mr. Deakin had come fresh from Victoria, and from the immense share which he personally had taken in compiling this new federal constitution, and, what was far more difficult than compiling it, fighting it through great legislative assemblies. These conventions were rema above all previous Parliamentary sittings in our colonies. They produced *Hansards*, whicl not only as voluminous as our own, but were mor able in one respect—that they showed a higher a level of oratory and of ability. He had som been accused of exaggeration when he had give opinion before, but those who were present afternoon, and had heard Mr. Deakin, would b to judge if he were not correct. The Abbé and other distinguished men in the French R tionary period were able to turn out constitutio the score, and very good constitutions many of were, but they had not to fight them throug assembly of this description. They had hear oratory and knew the tact with which Mr. Deaki his colleagues had fought through the matter, an could all form an impression of what was likely the statesmanship of the future Australian com wealth by the specimens which the convention si had already produced.

Correspondence.

LEATHER FOR BOOKBINDING.

In the report published in your issue of March of Mr. Cockerell's paper on "Leather for I binding," referring to Dr. Gordon-Parker's obs tion during the discussion on this paper, you pri "In conclusion he would quote from a book c the 'Leather Workers' Manual,' published by a in the trade, two out of many recipes for decor and colouring leather, one recommended the use bath of strong caustic soda as a preliminary to gil another gave a mixture of nitric acid, salts of tin fuming hydrochloric acid. If such recipes were by bookbinders and leather-sellers, he did not wo the leather decayed."

As the above remarks are thoroughly mislea when considered apart from the context in which above materials are specified, I would ask yo kindly give me space to put the facts fairly be your readers. Thus, as regard the bath of "st caustic soda," the following is the recipe referre by Dr. Parker.

"Decorative Gilding on Leather.—Gold leaf, s and other bronzing powders may be applied leather by the following process:—Free the ta leather of all fatty bodies by soaking it in a mec (*sic*) strong bath of caustic soda for a time, accor to its thickness, then take it out and dry it, a wards saturate it with a solution of isinglass alum, dry it in the air and then give it one or coats of a mixture of 2 lb. collodion, 1 drachm ca oil. Dry again, and then brush with a weak solu of caoutchouc in benzol, then apply the gil

nish, which is prepared from old linseed oil nish boiled with litharge and Venice turpentine. nen the varnish is dry, so that it is only slightly ky, lay on the gold leaf and bronzing powder h a brush and finally give a coat of mastic resin olved in alcohol."

feel constrained to repeat here the above recipe batim, so as to counteract the mischievous innces incident to Dr. Parker's remarks concerning ne.

Now, as my book is written especially for practical her workers, any currier following the above fora would know by experience how long to allow the her to remain in the medium strong soda solution, , just sufficient to cut the grease on its surface, so o enable the collodion to adhere thereto. Why Parker left out the word "medium" before rong bath," I do not know, but even suppose rong bath of caustic soda solution were applied eather stuffed with currier's grease, &c., very little n would accrue to the leather fibre (except by longed immersion, which would not be necessary the above case), as the action of the alkaline id on the leather would be simply to convert currier's grease into soap and glycerine, as the owing chemical reactions show :—

$$C_3H_5(C_{18}H_{33}O_2)_3 + 3NaOH =$$

Olein. Sodium hydroxide (*i.e.*, caustic soda solution).

$$NaC_{18}H_{33}O_2 + C_2H_5(OH)_3$$

Sodium oleate (*i.e.*, common soap). Glycerine.

the sake of simplicity only one constituent of the rier's stuffing is considered in the above reaction, , olein (*i.e.*, oxidised oleic acid), but as other fatty ls (stearic, palmic, margaric, &c.) would also be sent in the grease, and these acids would become dised into stearin, palmitin, margarin, &c., by the bibition of oxygen by the grease, other soluble ies (*i.e.*, soap constituents) besides sodium oleate ld also be produced, viz., sodium stearate, marga-, &c., but in all the reactive changes that occur eryl (C_3H_5) would become separated from the y compound, the radical glyceryl becomes glyne by uniting with three molecules of hydroxyl, —

$$C_3H_5 + 3\,OH = C_3H_5\,(OH)_3 \quad i.e. \left.\begin{matrix} C_3H_5 \\ H_3 \end{matrix}\right\} O$$

the amount of grease that would be "cut" (*i.e.* tralised) by the alkaline liquid would be very ll the quantity of glycerine produced would be nitesimal, but as both soap and glycerine are cible in water the action of the medium strong n of caustic soda on the leather would be fectly harmless under the above condition of , therefore Dr. Parker's critique on this formula alueless. The rationale of the above formula is this he surface grease is "cut" by the alkaline liquid, n the surface pores of the leather are filled up n the isinglass and alum mixture so that the surface of the leather shall present a smooth surface instead of a "bumpy" one, and then a layer of caoutchouc is spread on the leather so that no damp or greasy exudation shall rise through the leather to the gold or bronze powder.

As regards the other recipe Dr. Parker selected for condemnation, the doctor's choice was very unfortunate, because this recipe is copied verbatim from Davis's well-known work on "Leather Manufacture," a book which has been accepted by the leather trades as an authoritative one during the past twelve years or so; therefore in condemning this recipe (viz., mordant used in dyeing Russian leather), Dr. Parker is stultifying his own position as an exponent of chemical science to the leather trades, because if the recipe be so very terribly destructive—(I reserve my own opinion on this point)—to the leather, why has not Dr. Parker condemned it before, so as to warn the members of the trade who support him against its use? Twelve years to allow such a wicked recipe to flourish without a warning note from Dr. Parker argues that he had not been very mindful of the leather trades' interests. I am afraid Dr. Parker has been frightened by the words, "nitric acid, salts of tin, and fuming hydrochloric acid." Combine them, however, and then dilute the mixture with fifteen times its volume of water, and what do we get? A mixture nothing at all so destructive as the sulphuric acid that is used in plumping hides and skins, nor the sodium sulphide that is frequently used as a depilatory agent. But in considering this recipe, Dr. Parker is, as I have just pointed out, condemning himself. In justice to myself, I think it unfair for any critic to pick out bits of any book and give a different complexion to their meaning than what is intended by the context.

H. C. STANDAGE.
Consulting and Manufacturing Chemist;
Author of "Leather Workers' Manual," &c.

April 2nd, 1900.

CULTIVATION OF INDIGO.

Mr. Martin Wood, in the discussion on Mr. Rawson's paper on "Indigo," on the 29th ult., referred to my experience of its cultivation in the province of Guzerat. That cultivation had disappeared from that part of the country before I knew it, but the numbers of indigo vats still existing, though unused, in a large number of villages, especially in the Ahmadabad and Kheda (Kaira) Collectorates, testify to the industry having been largely in use in days of old. When it died out, and whether this was due to the cause to which its decay was attributed by Mr. M. Wood or not, I do not know, but I have written out to India to endeavour to ascertain, and will give the Society the benefit of what I may find out on the subject. It is one worth inquiry, with the object, if possible, of reviving one of the vanished local industries of which India is so

much in want. There are two great facts that point to the possibility of such a revival, viz., that it formerly existed, and that the plant is indigenous. Many parts of Guzerat are still greatly under the influence of the Vaishnavites, or followers of Vishnu, the Preserver of the Hindu Trinity, but if the question of the price of the manufactured article, the ultimate factor in the matter, should turn out to be in favour of the province, there would be many Mussulmans and low-caste Hindus who would not be scrupulous as to the infinitesimal amount of life that might have to be sacrificed, who could most probably be induced to revive the culture of indigo.

A. ROGERS,
Late Bombay C.S.

April 7th, 1900.

Obituary.

ROGERS FIELD, B.A., M.INST. C.E.—Mr. Field, the well-known hydraulic and drainage engineer, died at Hampstead on Wednesday, March 28. He was born in 1831, and was named after Samuel Rogers, the poet, his mother's uncle. He was a pupil of Mr. Thomas Wicksteed, the water engineer, and subsequently he devoted himself more especially to engineering works connected with sanitation, and designed and superintended the construction of the drainage and water supply arrangements of a great number of public institutions and private buildings in all parts of the country, including the drainage of Sandringham-house and Bagshot-park. The bylaws and regulations he framed in 1876 for the town of Uppingham were substantially adopted by the Local Government Board, in 1877, in their model bylaws as to drainage. Mr. Field was elected a member of the Society of Arts in 1876. He read a paper on the "Escape of Sewage Gas into Dwellings" at the Society's Conference on Health and Sewage of Towns, 1877, and he was a frequent speaker at this and other Sanitary Conferences. He was the inventor of Field's engineering aneroid barometer, the special feature of which is an adjustment for variation in temperature, enabling altitudes to be correctly ascertained in a very simple manner.

General Notes.

COPPER PRODUCTION, 1899.—The world's production of copper for last year was 470,866 tons, while that of 1898 was 429,156 tons, of 1889 was 261,000, and of 1879, 152,000. The average price was as follows:—1899, £72 16s. 6d.; 1898, £51 7s. 10d.; 1889, £49 10s. 6d.; 1879, £57 11s.

MEETINGS OF THE SOCIETY

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

APRIL 25.—"Industrial Resources of Portug[al]" By J. BATALHA REIS, Consul-General for Port[ugal] in London.

MAY 2.—"Some Unfamiliar Masterpieces of [the] Italian School." By Miss HALSEY.

MAY 9.—"Roads for Cyclists." By A. MORF[Y] WHITE. SIR JOHN WOLFE BARRY, K.C[.B.], Chairman of the Council, will preside.

MAY 16.—"A National Repository for Sci[ence] and Art." By PROF. FLINDERS PETRIE.

MAY 23.—"Salmon Legislation." By J. WIL[LIS] BUND.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

APRIL 26.—"English Criminal Procedure and [the] Indian Code of Criminal Procedure: a Comparis[on]" By SIR JOHN SCOTT, K.C.M.G., D.C.L. Right Hon. SIR FRANCIS HENRY JEUNE, K.C[.B.], D.C.L., will preside.

MAY 17.—The Industrial Development of Ind[ia] By JERVOISE ATHELSTANE BAINES, C.S.I.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

APRIL 24.—"The Practice of Lettering." [By] EDWARD F. STRANGE. SIR WILLIAM ABN[EY], K.C.B., F.R.S., will preside.

MAY 8.—"Art Metal Work." By NELS[ON] DAWSON.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

Prof. VIVIAN B. LEWES, "The Incandesc[ent] Gas Mantle and its Use." Three Lectur[es].

LECTURE I.—MAY 7.

The History of Incandescent Gas Lighting.—T[he] discoveries that led to the mantles of to-day—T[he] oxides suitable for mantle-making and their prepa[ra]tion—The services of thoria and ceria, and [the] methods adopted for their extraction.

LECTURE II.—MAY 14.

The Manufacture of the Incandescent Mantle, a[nd] the Influence of the Process employed on the Life [of] the Mantle.—Manufacture by impregnation of ve[ge]table fibres, and by moulding the oxides into thre[ads] —The recent advances in mantle manufacture—T[he] theory of the incandescent mantle, and the cau[ses] which lead to luminosity.

LECTURE III.—MAY 21.

The Gas Burners employed in Incandescent Lig[ht]ing.—The theory of the Bunsen burner—The ad[ap]tion of the Bunsen burner to the incandescent man[tle] —Modern burners and their aims—The effect of t[he] chimney — Chimneyless burners — High - pressu[re] burners—The influence of the quality of the gas [on] the conditions of burning—The use of water-gas [in] incandescent mantle burners.

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FRIDAY, APRIL 20, 1900.

'll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

H.R.H. THE PRESIDENT.

At their last meeting the Council of the ociety unanimously passed the following ›solution which has been transmitted to the 'rince of Wales and graciously acknowledged y His Royal Highness :—

"The Council of the Society of Arts desire to take ie earliest opportunity of conveying to His Royal ighness the Prince of Wales, President of the ociety, the loyal and earnest expression of their ›ep thankfulness at the providential escape of His oyal Highness from the execrable attempt on his 'e."

EXHIBITION OF MODERN ILLUSTRATION.

The Board of Education have decided, at ie suggestion of the Council of the Society of rts, to hold during the autumn an Exhibition ' Modern Illustration in the Victoria and lbert Museum, South Kensington.

The Exhibition will consist of works in black ıd white intended for book, periodical, and ›wspaper illustrations, and will be confined ›lely to modern examples of typographical ork executed since 1860. This limit covers ie time during which photography has been 'ailable for reproductive purposes, and during hich consequently the original drawings ıve been preserved, and are available for ‹hibition.

The Board will be assisted in the selection ıd arrangement of the drawings by an fluential committee, with some additional embers, which had already been organised ' the Society of Arts.

It is proposed that the Exhibition shall be opened about November 1st and remain open for four months. The drawings will have to be sent not later than October 1st.

The first meeting of the committee (Sir James Linton in the chair) was held on Monday, 9th inst., when an executive committee was appointed.

Any further information will be furnished on application to the Secretary, Board of Education, South Kensington, S.W., to whom all communications on the subject should be addressed.

POSTPONEMENT OF MEETINGS.

In consequence of the ill-health of Mr. Batalha Reis, it has been found necessary to postpone the meeting announced for Wednesday, 25th April, which will not therefore be held.

The meeting of the Applied Art Section announced for Tuesday, 24th April, is also postponed in consequence of the illness of Mr. Strange.

Sir John Scott's paper announced for reading before the Indian Section on Thursday, April 26th, is also unavoidably postponed until May 24th.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, April 3, 1900; William Luson Thomas, Member of the Council of the Society, in the chair.

The Chairman, in introducing Mr. Hentschel, said that at the present time, when important events so rapidly followed each other of the greatest interest, and artists and photographers all over the world were vieing with each other to produce a faithful pictorial record of our times, the public must be rather puzzled to know how all the innumerable pictures were produced ready for the printing press, and no one was more able to enlighten them upon this subject than the author of the paper, who was about to address them.

The paper read was—

PROCESS ENGRAVING.

By Carl Hentschel.

When I was asked to read a paper on process engraving before your learned Society I felt a certain amount of diffidence in accepting the honour—there are so many men who can

theoretically place all the facts connected with the various processes before you much better than I, but at the risk of being thought egotistical I must claim a larger experience of the practical working of process than anyone else in this country. My only excuse for standing before you this evening is the fact that I have grown with this special art, having assisted my father when quite a youngster, and for the last 22 years have devoted myself entirely to its development, improvement, and practical application. It is therefore as a worker—as a business man—I speak to you now. No doubt there are others present, as I say, theoretically qualified, and better able to endow this technical subject with literary merit than I am, and I shall make no effort to emulate them, but simply base all I have to say on my personal experience in working the process, to which I shall add a few general facts I have collected in my endeavour to make this brief history as interesting as possible.

The earliest form of engraving was that used by the Assyrians for the purpose of stamping impressions upon bricks and other articles in clay, other stamps were made in brass for marking cloth, and it is said that these stamps were also used for branding slaves. About the end of the 14th or the beginning of the 15th century the German card makers, it is believed, adopted the principle of engraving in relief for the purpose of impressing the outline of figures upon their cards, the outlines being afterwards filled up with colour.

In the Spencer library, formerly at Althorpe, there is a copy of the celebrated woodcut of "St. Christopher," dated 1423. Its authenticity has been so well established that its production may be accepted as the historical starting point of this branch of the art of engraving. The impression was produced by printing and not by burnishing.

Engraving as a means of book illustration may be said to date, not from the time the art was discovered or first practised, but from the time when the plate being engraved means were at hand to readily multiply impressions from it.

It is recorded that Thomas Bewick and Robert Branston were the pioneers of wood engraving in England. Branston was originally a copper and steel plate engraver. The earlier wood blocks were cut with knives, not gravers. It was to John Thompson, a pupil of Branston, that the art of wood engraving was indebted for its early progress. He improved the tools, gave great care to the choice of material, and brought a large amount practical study and artistic ability to tl successfully achieved task of spreading abro into a wider field the growing demand f wood engraving.

Without tracing wood engraving down to tl present period, it is interesting to point o that the very element which worked so mu evil to steel and copper engraving was so active in lowering the artistic quality of wo engraving—that is to say cheapness (one the traits of education and civilisation). At tl present day the same thing is happening, so suppose it will always go on, the insidio influences of undue rapidity, cheapness, a up - to - datism undermining artistic wor Wood engravers began to aim far beneath tl aspiration of those who preached the old methods, apprentices began to do for wo engraving what inferior assistants had do for the old copper and steel engraving, and, fact, artisans took the place of artists.

Amongst those who will always take a hig rank in the modern English school of wo engraving are:—John Jackson, H. Linto W. J. Linton, E. Landells, W. T. Gree J. W. Whymper, W. H. Powis, Joseph Swai W. L. Thomas, G. and E. Dalziel, Mas Jackson, and many others.

Before plunging into my subject—process I will briefly describe wood engraving. Th design is first made on a piece of boxwood, specially hard wood which allows the engrav to cut clear and sharp. In the case of a large cu these boxwood blocks are made of several sma pieces, which are afterwards screwed togethe so that sometimes ten or more engrave could work on the same design at the sam time. Before the advent of process, when th *Graphic* and *Illustrated London News* we all engraved on wood, you will find, if yo carefully examine the early numbers, fine whi lines or cracks running right across some the blocks. These were caused by the joins i the block. The design was generally draw in pencil and body colour, the blocks bein first coated with a white solution.

These methods were employed until abo 1866, when instead of the drawings bein made by the artists on the wood, they bega to be drawn on paper, and then photographe on to the block. This was a great improve ment, because the artist could make hi designs any size he wished, and have the photographed down to the required size; an the drawing had no longer to be reversed.

My first experience in producing illustra

ɔns was in assisting my father in photo-ɾaphing drawings on wood. I remember ɔrking for some of the best and leading ɔod engravers of that period. My father vented a process for this purpose, which ıs afterwards adopted by the late John vain. I have a vivid recollection of a very mple process worked by my father which he ·pt secret, it being too simple to patent. He ok a photograph, *i.e.*, an albumenised silver int, and pasted the photo face downwards ı to the plain boxwood. For pasting he ed some special glue of his own; when dry merely rubbed the paper away with his ıger by moistening it. The paper very sily coming away, the photograph was ft on the wood. My father discovered is quite by accident: an old photograph ving stuck on a wood block he started bbing the paper quite absent-mindedly, ıen he perceived that the albumenised film the silver print remained on the wood.

The final step which brings us to the esent time, though not by any means, I am re, to the end of the chapter, is the super-ding of the wood engraver by the mechanical process engraver.

Photo-engraving, which is in reality pro-ss, is older than photography, since Niepce 1814 commenced experiments, and in 1824 not earlier) actually produced proofs from oto-etched plates. His process was just purify bitumen and then to coat a silver pewter plate with it, exposing to light der an engraving or in the camera. The umen, where it became insoluble under the tion of light, resisted the solvent action of of lavender which was afterwards applied, that a resist was produced and the plate was erwards etched. The only records of Niepce's rly experiments are furnished by some cor-spondence between Niepce and Daguerre.

Eventually Niepce entered into partnership th Daguerre and endeavoured to form a com-ny to work their new invention, but without ccess—capitalists looked upon it as much too ky a venture. Niepce's desire and object ıen the first glimpse of photography appeared s to find a substitute for engraving. Letters itten by Isidore Niepce at that period tend to ow that from Niepce we obtained the germ d idea of process engraving.

The first published results of the Daguerreo-pe process proved that the nitric acid acked the silver forming the dark part of image, whilst it had no action on the rcury in the light part. After a few minutes biting the plate was washed, inked up, and proof pulled, but the results were very imperfect, and the plates did not stand printing owing to the softness of the silver.

In 1842 Poitevin endeavoured to prepare printing plates from Daguerreotypes. Fizeau improved this process and obtained results, resembling photogravures.

Fox Talbot's first process was patented in 1852. This process was called phototypy. Up to this time it may be said to have been the most important process of the day. It is curious to note that Talbot when copying what we now term a half-tone subject, used what he called a photographic veil over the plate; this veil was composed of two folds of thin black gauze, the method was imperfect, but it only shows that at this time Talbot was endeavouring to make half-tone blocks by means of breaking up the tones by the aid of a gauze or screen. In fact, he actually suggested the use of those glass plates, ruled with fine lines or covered with opaque dots, which are the basis of half-tone work. But in referring to this process, it must be borne in mind that it was really a species of photogravure, and was not a process for producing type blocks for printing in magazines or newspapers—his plates had to be printed in a copper-plate press—the plates he made were, however, the first of their kind, and very excellent. Talbot may well claim to be the English inventor of photography.

Carl Klic, of Vienna, is said to have improved upon Talbot's methods considerably. The idea of a lined screen was followed by Berchtold, in France, and C. J. Burnett, in England, in 1857 or 1858. In 1861, Baron F. W. von Egloffstein experimented with ruled screens in Philadelphia, and in 1865, E. and J. Bullock patented and worked for fifteen years a process in which the grain was produced by a line netting of cross lines.

The earliest attempts in the direction of automatic engraving were based on the principle of biting away the metal with acids. The great difficulty encountered was to ensure that the action of the acids should be exercised only in the direction required. Nitric acid had a habit of etching away the delicate parts, and even at the present day it is not unusual for this to occur. Many experiments were made, but for a long time the results were failures. It was left to a Frenchman, M. Gillot, to perfect the etching of the line block. I have just received an interesting letter from M. Gillot, jun., who states:—

"My father, who was a lithographic artist, took over a small lithographic business whose specialty was printing small labels. The lithographic method not being quick enough it struck him to bite or etch the stone deeper to enable him to print typographically instead of lithographically. Whilst experimenting on this the idea occurred to him to use metal: he therefore experimented, and successfully succeeded in etching on zinc. This took place about 1848, but the printers were very much against the new method. After six years' patient work he submitted his invention to the Society for the Encouragement of National Industries. He called his process "Gravure Paneconographique," a name still in use at Messrs. Gillot's at the present day."

Gillot encountered, as is usual, an amount of professional opposition—the French engravers were averse to helping the new method by any encouragement, dreading that the new process would supersede their own art. Publishers also spoke disparagingly of it as "The Process," and in consequence of the disrespect with which the term was then associated, M. Gillot adopted the title of Gillotage for his work. It was M. Phillipon, of the *Journal Amusant*, who came first to his assistance, and foreseeing the value of the process, gave up all wood engraving and used Gillot blocks instead. M. Gillot was greatly assisted by his wife, who was a good artist herself. M. Gillot died in 1872, after having invented and perfected one of the most important inventions of the century, and founding the first and most important process establishment in Paris.

The earliest public recognition of its value was at the Exhibition of 1855, when the distinction of Honourable Mention was conferred upon the process.

My father had for many years been experimenting with photography on zinc, but it was not until after many years of labour that he succeeded in perfecting his process sufficiently to practically work it, and then only by adopting the Gillot method of etching. It may be interesting to mention that the first etcher who came from Gillot of Paris to introduce the method into England in 1876 is still working for me.

It is curious to note that although forty years have passed since Gillot invented line zinc etching, the method has not much improved. His method was perfect, and the results obtained then were equal to those of the present day. (I am referring to pen and ink or line work.)

It must not be forgotten that all the early plates were either drawn on zinc or on transfer paper or lithographic stones, and then transferred to zinc and etched. was not till later that the method of phot graphing direct on to the zinc was adopte It was my father who at that time w endeavouring to photograph direct on to zir and his process, by those who were capab of judging, was considered the finest ev introduced. Mr. Comyns Carr, in a lectu before this Society, referred to it specially a described it; but a certain amount of patien was required to get any decent results. In t early days I had to do all the practical work, take the negative, print it, and prepare it rea for etching. The difficulty was in obtaini the result on zinc—the only methods then in u was either by albumen or bitumen, neither them perfect if you desired to obtain delica results. Another method employed previous to this was to prepare albumenised sensitis paper, to print the same and ink it up, and th to treat the print as a transfer by transferring on to the zinc in the same manner as a lith graph. My father's process was in the form of sensitised carbon paper, which was printed a then squeegeed without pressure on the zin thereby retaining all the fine lines, and n smashing them as was the case with t earlier transfer method. After the carbon w developed the plate had to be carefully etch and then rolled up. It was here that t difficulty arose. A certain knack was requir to ink the plate, owing to the plate "tinting *i.e.*, the white parts inking up as well as t picture, and to such an extent that one cou not remove the blemish without damaging t work. I found a solution (nut gall) whi helped me greatly in getting rid of this tir but although I tried to teach a good ma I only came across one man who had t knack of doing it. This process was work for some years, until with the advent of im provements, and the increased output blocks, I dropped it.

When Klic was last in England, about t year 1883, I assisted him in experimentin in the reproduction of half-tone engravin Meisenbach was just then coming to t front, and Klic had some scheme of makin cross-lined screens. His idea was to mal these screens photographically by phot graphing a single lined negative both way and reflecting the light through the lin negative in such a manner as to secure a sc of halation or softness between the points th the lines cross. Dry plates were used at th time, and instead of using daylight or electr light, a very strong bull's eye lantern and

pid dry plate were used. Although a lot of periments were made nothing came of them. am afraid I had not much faith in the ocess, and was not really enthusiastic over My father and myself experimented on aking different screens. We had one idea making a sort of chess-board screen consting of black and white squares, and for is purpose we got an artist to make the ard, and for six months he worked on this etched inartistic mechanical work, nearly nding himself, as the board had to be luced so very much; the results were too iall to be practically useful.

At that time wire gauze was used, also lace d silk. Some fine results were obtainable rough the wire gauze, but the scientific inciple and method of breaking up the dots d not been discovered. It was Mr. Ives who st went thoroughly into the matter, and iose researches and experiments have proved great value to the trade. There have been good many processes which would have oved useful had they been workable comercially, but when an inventor brings you a w process and shows you the result he does t tell you how long he has been preparing specimens and how long it has taken him perfect the one he shows you—all he knows that theoretically it can be done in, say, two ys, not telling you that it took him perhaps nonth to obtain the result he is showing you. y father had an idea of making half-tone reoductions without the aid of screen or grain, d certainly he did succeed in getting examples stone which were simply marvellous. Had process been workable, it would have volutionised lithography, for he obtained licate half-tones from the stone. His method s briefly as follows:—He prepared a carbon per upon which the picture was exposed der a negative, the paper was transferred to stone, not with pressure, but simply by ueegeeing it. After the print was soaked, paper was taken off, the carbon was left on stone and developed, we then had a autiful photographic print on the stone. is was dried and then slightly etched with ric acid, after which the carbon picture was shed off and the stone was treated in the linary way—that is, inked up—and the effect the process was that all the half-tones were ained. Messrs. Maclure and Macdonald d one of these stones, and tried it on their ichine, and had no difficulty in printing from as the more they printed the better the picture came, because owing to the porous nature of the stone and the action of the carbon tissue, the picture had sunk right into it. But it was impossible to work this process; it was the most erratic process ever invented. The specimens I referred to took about twelve months to prepare—that is to say, about 40 had to be made before we got a good one. But it was the first and only process ever invented that enabled a pure half-tone to be printed direct from the stone. The process was a secret one, and my father and I were the only ones ever to work it. There have been various processes, such as Heliotype, Phototype, Collotype, &c., but all these were printed from gelatine films or moulds.

There was a very curious process at this period which I saw worked, and that was to get a reproduction either enlarged or reduced from existing pictures on stone or wood. You had a large piece of smooth india-rubber stretched in a frame, which you contracted or stretched, according to whether you wanted it reduced or enlarged, and some very good results were shown. The process was amusing, inasmuch as you could distort a picture to any extent you liked, and with portraits you could get the most comical effects. Those comical india-rubber faces that children play with or one of these distorted mirrors will give you some idea of its comicality.

Pretsch blocks were really the first half-tone grain blocks. Pretsch discovered that the bichromated gelatine film possessed the property of reticulating itself with minute vermicular markings, when it is wetted after the usual exposure to light. This is specially noted when the film has been rapidly dried, and when it contains a portion of chloride of calcium; the reticulation varies according to the heat at which it is dried, according to the exposure, and to the light and shadows of the picture. The one fault with this process is that the grain may become unduly prominent and so destroy all fine detail.

The Pretsch process was developed by Swan, who obtained the gelatine relief with carbon tissue, thus avoiding irregular swelling and granulation of the gelatine, and afterwards by Geymet, Roussillon, and Dawson among others. General Waterhouse in 1880 used fine sand sifted in the gelatine relief on a copper plate while it is still soft.

Messrs. Sprague's process must be mentioned as being based on the reticulated gelatine grain principle. They have used this process very successfully in connection with supplements for various papers and insets;

most of their reproductions being printed from stone, the type-high blocks not being so successful as those results from stone. They call their method the Ink Photo Process.

Although several attempts have been made to introduce grained half-tone blocks, the result has not been successful, because they lack depth, and have not the softness of the ordinary half-tone block. The finest results, so far, have been done in France, by Goupil, but then they have had the advantage of exceptional printing.

Amongst other processes was one called the silver line process. It is a very pretty process, and a Frenchman I knew in the eighties induced several publishers, to their loss, to work it. One well-known publisher in those days, who dabbled in process, always considered his downfall due to the money he had sunk in endeavouring to bring this process to a successful commercial issue. The silver line process was to coat a zinc plate with bitumen, expose it under a positive, so that after developing, the plate was etched slightly, and a metallic alloy capable of resisting the acid deposited on the lines. The process, owing to its pretty appearance, charmed a good many, but it also proved costly.

Another inventor tried to make use of glass as a substitute for zinc in the preparation of surface blocks by the etching method. Hydrofluoric acid instead of nitric acid was used. It was proposed to use it for large pictures for illustrated newspapers, and to some extent this was carried out in a paper published in Australia, but I cannot find any facts relating to this. I only mention it as a curious experiment. In endeavouring to give a brief report of process engraving I find the records on process are really very meagre. This is owing to the fact that an endeavour was made to keep most of the processes secret. Although a good many processes have since come into existence the differences between many of them are very slight, many being merely variations on some small point.

Another process in use in the early days was the gelatine process. This consists in printing the picture on a sensitised film of gelatine; if this gelatine is soaked in water, the parts representing the whites swell, and the darks, really the picture, remain as they were, as the light has rendered them insensible to water; from this swelled gelatine mould a cast is made, and electrotyped. The process is used only, I believe, by one firm, Messrs. Dawson. Some of the results obtained are very good, but I am afraid now-a-days the process is looked upon as old fashioned.

Messrs. Dawson also worked another process by which some very excellent results have been made, and it has held the field for a considerable time for special classes of bookwork, but of course for rapid periodical work it was not suitable. They called this process typographic etching. This process differs from all others. It has less of a mechanical nature than the modern process, and it depends upon the skill of the draughtsman who works it. The design is drawn with an etching needle on a metal plate covered with wax, the metal is therefore bared at the lines, which are separated by ridges and spaces of wax. For outline work the process is admirable; elaborate drawings can also be made, and they are best made by the artist himself who is familiar with the etching needle, but artists are slow to adopt any little training which would have made them proficient in sketching on the prepared surface. In referring to this excellent process, one is reminded of the process called the Glyphographic process invented by Edward Palmer about 1842. There is no special interest attached to Palmer's process beyond an earnest and unsuccessful attempt to supersede wood engraving. The process never came into practical use. It ruined its inventor, who gave up a good business as an optician and found himself in the Bankruptcy Court, not an unusual proceeding for inventors who have tried to bring process engraving to a successful issue. Your true inventor seems essentially drawn towards the Bankruptcy Court, and has hardly ever derived any benefit from his inventions; it has generally been some smart business man who has taken up an old idea, improved it, and gained the credit and kudos which really never belonged to him.

Amongst the processes which were a good deal advertised, but came to nothing, was the Sutton process. A syndicate was formed to run this process, and a demonstration, including a luncheon, took place for the benefit of the Press, who, not having a practical knowledge of process work in general, gave glowing accounts of it. It was demonstrated that blocks could be made in less than half an hour, but what was obtained was only a gelatine dry plate cast from which an electro had to be made. The results were by no means good, and the syndicate, after working it for some time, disappeared quietly in the usual manner of unpractical syndicates.

Amongst numerous processes the Swan process is worthy of mention, but it does not appear to have been developed or used commercially.

Mr. Woodbury also attempted to make type blocks from his reliefs. His process—Woodburytype—although in much demand at one time was only adapted for supplements and insets, as the prints were from intaglio gelatine moulds and not adapted for type work. Mr. Woodbury made his block by breaking up a transfer taken from his mould and transferring it on to zinc to be etched.

Mr. Ives, in 1878, patented a process: his plan was to take an inked Woodbury relief and to press it against grained or embossed paper, the picture on the grain paper was then copied in the camera or transferred to zinc direct. In another improvement of his he took a cast in plaster from the Woodburytype; on the plaster cast he printed lines or stipples by means of an indiarubber stamp. By flowing the plaster over with collodion he was able to transfer the ink to the resetting film, and after slipping the film off he made a print from it on the plate.

Some thirty-four years ago the Graphotype process was in use for a short time and, although to a certain degree ingenious and original, it was not found sufficiently practical. Briefly the process was as follows:—The drawing was made in an ink consisting of glue and lampblack upon a block prepared by compressing precipitated chalk into a solid cake. When the drawing was completed the whites between the lines were brushed out, the block was treated with silicate of potash to harden it, and electrotyped.

In commenting upon what we may call the chalk block period, my father, August Hentschel, worked a similar process, with the difference that he used photography in connection with it. His was a mechanical process—the drawing, which had to be in line, was photographed on to cardboard, which was coated with a thick solution of caseine, plaster, and other ingredients sensitised with bichromate, this was placed between a roller to take off any unevenness, and then exposed under the negative. It was then developed, and the parts unexposed were washed away, leaving the picture in relief—this was dried, an electrotype was taken, and the large white spaces were deepened by the aid of an engraver. Now this process was a pure mechanical process as it gave an absolute facsimile result of the artist's own drawing, which the other chalk process did not give, and some very good results were obtained—but at that period publishers were not so sympathetic in adopting any new process.

It is interesting to look back upon those early days, and compare our present methods. I can well remember a time when if a block was turned out in a week it was thought something wonderful; afterwards when I succeeded in turning out a block in 24 hours it was specially noticed in the Press, and when a double-page pencil drawing by Melton Prior for the *Illustrated London News* was reproduced in nine hours the fact was regarded as marvellous. Now-a-days half-tone blocks are wanted in two to four hours and line blocks in two hours. It is nothing unusual to have to deliver a double page block from a wash drawing in six hours, and in some cases we are expected to make the blocks in less time than that. There is no doubt we are arriving at a time when it will be almost possible to supply blocks whilst you wait. From an artistic point of view this is to be deplored, but we live in an age of nervous rush, and one must go the pace or be left behind; it is the pace that kills the workmen as well as his art, for certainly no one can put his best work into a block when only minutes are allowed for a difficult process requiring hours. I can call to mind in 1879 having some very difficult old engravings to reproduce; they were for a book on "Marie Antoinette" by Lord Ronald Gower, and it took the best part of a year to do what now could be done in a week. It was not a question of getting it right there and then: oh no, it was a case of doing it over and over again. You can imagine the monotony of re-doing the same picture until it was perfect. A portrait of Cetewayo which I was doing then is so vividly impressed upon my memory that to this day I seem to see every line in it. I had to do that wretched portrait about fifty times before I could get it right. It is no wonder then that the company which worked this process in its early days came to an untimely end. (The title of the Company, by the way, was The Direct Photo Litho and Metallo Gravo Printing Company, Limited.) Another thing to be considered was that in those days every one was prejudiced against process or zincography, as it was then called; wood engravers were up in arms against it, printers said it could not be printed—(printers always do say that). I have found that printers are really the most conservative of conservatives, and will not touch anything new unless forced to do so.

Zincos were then not so deeply etched and required more delicate handling than wood-cuts, and when Meisenbach blocks came into existence the printers had, much against the grain, to change their method of printing. Soft backing and heavy blankets and rough paper would not do, and the early results of Meisenbach blocks were really heart-rending; but luckily the proprietors of the *Graphic*, the *Illustrated London News*, and *Lady's Pictorial* saw the value of this process and assisted in improving the printing, and printing has steadily gone on improving.

Being on the subject of printing, I may just refer to the process blocks made for the *Daily Chronicle* some five years ago. It was due to Mr. J. Pennell's energy and enthusiasm that the *Daily Chronicle* went in so largely and extensively for line drawings, and all by the best artists of the day. The results were exceptionally good, and a good many wondered how it was that they printed so well, keeping all the delicate lines and quality. The fact was that they had adopted a method I suggested, namely, that of using original blocks for every one of their machines and bending and fixing them on the cylinder. There was a little prejudice in adopting this method at first, but when it was tried the results were perfect, and have never been equalled. Unfortunately, time not always permitting this for their occasional illustrations now, they stereotype them and the result is nothing like so good.

One always hears that they hurry along things in America. Well, from my own experience, blocks have to be produced in much shorter time here than in America; for instance, as a record of quickness, I may mention that over 30 square feet of line blocks had to be, and were, delivered within nine hours, and on that same day my firm had to turn out in all 70 square feet of blocks in twenty-four hours, and, in spite of this rush, the blocks were all perfect; the blocks included those large page illustrations that appeared in the *Daily Chronicle*. These page illustrations were by the way the largest zinc blocks that had ever appeared in any newspaper. To realise this quantity of work you must consider how many wood engravers would have been required, and how long it would have taken them to engrave 70 square feet of blocks.

Meisenbach must be credited as the inventor and pioneer of the half-tone process. He patented this process in 1882. The effect was that wash drawings, oil paintings, water colour drawings, in fact anything that could be photographed could be reproduced direct without having resource to re-drawing it in pen and ink or engraving on wood. It is this process which has killed wood engraving all over the world. The important feature of the process was the use of a finely ruled glass screen, which was interposed in the camera between the original and the negative, the effect being to break up all the gradations and half-tones into different sized blacks and cross lines. In the early days Meisenbach used single lines for these and by shifting the same in the camera obtained these dots and cross lines.

Mr. Ives really improved upon the Meisenbach method, for whereas Meisenbach used a single-line screen, and withdrew the line-screen during exposure, and replaced it instantly in a transverse position, producing thereby a cross-line effect; Ives obviated this turning operation by putting two of his machine-ruled screens together, face to face, and sealing them. The diamond-ruled screen of to-day is practically the same as Ives's early invention, although Max Levy improved upon it by producing it on his improved engraving machine.

Many other experimenters stumbled over similar experimental results, but it was not until Dr. Eder wrote his treatise on the "Formation of the Dot in Half-tone," and was followed by contributions from Count Turatti, E. Deville, Max Levy, Ives, and others, that the theory and principle of what Ives called the optical V were made generally public.

The enamel process, which was discovered by an American named Purbeck, greatly assisted in improving process work.

Amongst the processes for the purpose of converting photographs into half-tone blocks may be mentioned the Luxotype process of Brown, Barnes, and Bell, in which no screen was used, but the part to be copied was embossed by the aid of a wire gauze and plate by rolling or pressure, and this embossed print was strongly side lighted. The results were not satisfactory—whether the process was ever worked commercially with success I don't know.

Another method of making a grained negative without a screen was suggested by Messrs. Krantz and Zeisler. An image of the subject was projected lantern fashion on a white screen, ruled with black lines, and the composite subject photographed. In using a gauze or ordinary line screen the tendency was to get a monotonous flatness, and the effect had to be obtained by what is called fine etching—

nethod by which the original artistic drawing s often etched away beyond recognition, since the detail of the original had to be : in, everything depended upon the artistic ll of the etcher. It was owing to this ount of fine etching required and the flat ult obtained that process blocks in the early ys got such a bad reputation from artists.

Hand Engraving.—This is a point upon ich a good many people differ, but there is doubt that a good engraver may considery improve a block. Unfortunately, however, lishers want their blocks done at so much a iare inch, and will not pay for extra work. If y editors and publishers would realise that vould pay to spend a little more money on ir engravings. I do not say anything about ekly periodicals because there it is a question time, but it is gratifying to see that the *aphic*, whenever possible, spend a certain ie in hand engraving the blocks. Wood gravers are now turning their attention to cess work, and with their artistic skill ought be able to improve and work up process cks. To what extent this can be done one s only to scan the American periodicals. t if a good wood engraver has not had the per training for engraving on a process ck, then he had better leave it alone. To grave a process block well requires proper ining. The point to consider is whether older wood engravers will take the trouble learn it, or whether a new school of envers on process blocks will arise.

The *Century Magazine* shows the finest imples of this class of work, and what I am d to see is that they acknowledge the wood graver's name under each block.

t was about 1883—the advent of the Meisenh process—that things got a little forwarder. isenbach fairly revolutionised process enving. It was the advent of the American een and the beautiful results obtained in ierica that caused a rush of process firms to started in England. The firm to show the d in using the Levy screens and produc the finest work at the time was dre and Sleigh, and, certainly, for some irs they held a good lead, but with the eens and improvements from America bening universally known, good work was ie by several firms. Meisenbachs gave their old screen and took up the Levy een as well, so that after a time it became survival of the fittest, and it is curious to e that in spite of competition the old firms, h as Meisenbach, Swain, and Hentschel, all established since 1887, have held the lead for turning out good work.

Amongst firms who must be mentioned as doing fine work are the Swan Engraving Co., Ward & Co. (who both had the advantage of Mr. Ives' personal experience), the Art Reproduction Company, whose workmen first came from Angerer and Goshl the well-known Vienna firm. It may be interesting at this point to give you some idea of the progress of process and the decline of wood engraving as shown in the London directory :—

	1876.	1879.	1884.	1887.	1895.	1900.
Wood Engraving ..	—	130	162	158	131	80
Process	1	2	6	14	53	56

The first process firm in England was Leitch and Co., and the firm was started by the proprietors of Kelly directories ; the business was eventually taken over by the late John Swain, the wood engraver who foresaw the future of process. The second firm was Cattell and Co., which consisted of some of the original *employés* of Leitch and Co.

Out of the fourteen firms in existence in 1887 there are only five at the present moment existing, and out of the fifty-three firms who were doing business in 1895 twenty-two have gracefully retired. It is interesting to view the figures and notice the increase of process engraving since 1879 to 1900, but although there was a great rush between 1887-1895 to enter and swell the ranks of process men the last few years has shown a steady decline. Competition and cutting prices has been the ruin of those firms who rushed into business on insufficient capital and with little experience.

Wood engraving has not been able to compete against the rapid strides process has made. Mechanical processes which have been the outcome of photography have educated the public eye to a more delicate, more minute style of work—the public taste has been influenced by photography, the simple outlines which were once accepted as satisfactory now no longer suffice, and it is perhaps unfortunate from an artistic point of view that the public have taken so much to photographs to the detriment of the artist, for although photography is excellent it could be made so much more artistic in conjunction with an artist using his artistic feeling to embellish and improve the picture.

The precise style of illustration that may be fashionable at any time will be partly a matter of taste, partly dependent on the means at the

command of the artist and the process in vogue. At the present day the artist has not to restrict himself to the extent he did in the early days as to how he should draw for process. My own feeling in the matter is that artists should be allowed to draw and use what material they like, it is the business of the engraver to invent a process which will reproduce the artistic effect of the artist. The rapid strides that process, and especially half-tone process, has made enables us to reproduce any drawing no matter how drawn, whether in wash, pencil, or any other material. When process first came into use every artist had to draw only in line or grain, no half-tint or tints were permissible, and he had to use black ink or brown ink and white paper. There is no doubt the restrictions placed upon artists by the photo-engraver seriously hampered the artist and helped to render his drawing mechanical. Very few artists seem to grasp the idea of drawing with that crispness necessary for a line process block. How often have I been handed a drawing on yellow paper drawn in blue ink, and have been expected to obtain a satisfactory result, and how often the lines were drawn so faintly that it was necessary to force them up to make any block. What was the result? All the feeling was gone, and the process engraver was condemned as usual with, "What can you expect from a process block?"

But after all that one may say against process—and a lot of hard things have been said about it, and especially by artists, who have forgotten that the very advent of process has been the means of creating more work—let us only consider for one moment whether so many illustrated periodicals, books, or newspapers could be published now had it not been for the aid process has given to the publishers in enabling them to place before the public what was an impossibility in the days of wood engraving. Process is not perfect yet by any means, but its progress is by no means at an end, and one conspicuous advantage it has over wood engraving is that the actual work of the artist is more faithfully reproduced than by the wood engraver. You may retort, "Yes; but not so artistically, because your wood engraver was an artist, and your process engraver is a machine." Suppose we grant this; but the process engraver, although a machine, endeavours to throw all the artistic skill possible into his work. If, owing to the rush of the present day, he cannot do this to every block he should not be blamed for that, but the publisher, and especially the pub should be blamed, for all they seem to wa is cheapness—cheapness and rapidity. you offer a publisher better work, he of replies: "Oh, I know the work is mu better, but the other is good enough for t public!"

The impetus process has given to illustra journalism one can only realise after exami ing the illustrated periodicals for the last years; the progress has simply been marv lous, and the subject is so large and so i teresting a one that it would take hours enumerate or even give the briefest history of For instance, about 1883 there were only f 6d. weekly papers, using about 80 bloc nearly all wood engravings; now there about fourteen 6d. papers using some 1,0 process blocks every week.

Process work has been instrumental assisting towards establishing daily illustra newspapers, and it was left to the propriet of the *Graphic* to found the first illustra daily paper, which became a success. It interesting to note how in the early numb there were not so many topical illustratio Mr. Carmichael Thomas, in a paper this Society, described the production of *Graphic* in a most interesting manner. the early numbers no half-tone blocks w used. It is only lately that, owing to special methods that have been adopted making half-tone blocks suitable for ster typing, the *Daily Graphic* have used them much.

It seems like retribution that, go-ahead the Americans are, it was only recently that American daily paper asked the proprietors the *Daily Graphic* for information as to h they got their half-tone portraits so succe fully made and stereotyped.

There is no doubt as process is improv so will manufacturers have to improve th printing machinery. With the advance a co-operation of both it will be able in the n future to publish a daily illustrated paper eq in get-up and printing to the *Graphic*.

Both the *Illustrated London News* a *Graphic* were very chary for a long time using process blocks; occasional blocks w used in the *Graphic*. The first line blo which was a map, was printed in 1876, and t first half-tone by Meisenbach was in 1884. T *Illustrated London News* used an occasio map about 1880, and in 1886 a double page a peared, partly consisting of wood engraving a partly of process work which had been drawn

alk grain paper. The same year some very od specimens of Gillot's blocks appeared, d in 1887 a half-tone block (very fine grain) Goupil appeared—it was one of Paris Salon tures. In 1888 Meisenbach blocks obtained ooting, and from this year onward half-tone cks and line blocks steadily but surely crept and wood engraving had to give way. It is ticeable that in 1888 the *Illustrated London ews* only contained 26 pictures, made up as lows:—17 wood engravings, 7 line blocks, d 2 half-tones, whereas one of the present mbers contains more than 50 process blocks d no wood engraving.

The *Sporting and Dramatic* was the first penny weekly to go in boldly for line zincos, d the *Sketch* may be reckoned as the st sixpenny periodical to be illustrated tirely with process. In the first number in 93 there appeared 49 line, 46 half-tones, d 1 wood engraving.

In comparing a number of the *Illustrated ndon News*, in 1884, with a number of e *Sphere*, 1900, I find that the average mber of illustrations in the *Illustrated ndon News* was about 20; in one of the st numbers of *The Sphere* 90 illustrations pear, all process.

A process which will have a future before it the three-colour process. The process is a st fascinating one and one upon which I ve worked for some years. My process, ich I call Colortype, differs in many respects m all other processes. The process is to produce by the aid of the three primary lours any coloured originals. The blocks e made in red, yellow and blue, and are inted, the colours being superimposed one on the other, thereby obtaining all the aduations and blending of the original ture. The theory and science of this ocess were so minutely and interestingly scribed by Mr. Sanger Shepherd to this ciety some weeks ago, that I need not dwell on them.

Printing.—This is always a sore point: the ocess engraver always gets blamed for his ck if the result is bad. "Oh! it's the ck, the printing is all right." Although gland has made rapid strides in its printing is still far behind America, and why this ould be I cannot understand. Printers will t understand that a printing room should be pt as clean and as evenly heated as a studio but what do we find? The machine room generally somewhere in the basement, but at would not matter if the surroundings were kept as they should be, and an even temperature kept up; now, an even and warm temperature is one of the main secrets of good printing, and yet how little attention is given to it. The fact is the whole question of blocks, ink, printing and paper, is not sufficiently studied together; one man orders the ink, one the paper, one sees to the printing and another to the blocks, but there is rarely a capable practical person who will see that the co-operation is secured which is necessary toward getting the best result. It is a case of each one for his own department, instead of working together. England has good artists, can supply blocks superior to any abroad, and England should be in a position to compare favourably with America. Let the printers give their attention to this, and the day may come when America may learn something from England. Whatever credit the English illustrated press may claim for the progress it has made, I think process has had a good deal to do in furthering this success.

Having, I am afraid, taxed your patience to a considerable extent, I will conclude my paper with some lantern slides, illustrating different specimens of engraving, also showing how process blocks are manufactured, and the different departments a block has to pass through. I am enabled, by the kindness of Mr. Sanger Shepherd, to illustrate to you the principle of the three-colour process, exhibiting the effect of the three-colour blocks.

DISCUSSION.

Mr. JOHN LEIGHTON, F.S.A., said that they were very much delighted and interested by what they had heard. It was unfortunate that the word "process" had been adopted, as it was a most absurd title and meant nothing. The French called "process" photogravure, and he should have thought that some such name as heliograph would have been more proper. Metallic relief had been much sought after in order to supersede the work of the engraver, as the expense of engraving was often more than that of drawing. Zinc had been used for many years, and he remembered, in the forties, asking Professor Faraday what was a good resister of acid, and he told him to try borax. He (Mr. Leighton) drew on zinc with a brush and then etched the ground away, and found he got thereby a slight relief; it was but just capable of printing. There was another early process, called glyptograph, in which the drawing was made through a surface of plaster, when a stereo was cast into it. After

followed Gillot's process, some of the results of which were sold as etchings, being produced on India paper prepared with a false plate mark. He thought it would be a good thing if there could be a chronology of the different steps which had been taken in connection with this matter of relief printing surfaces. An attempt was once made to get up something of the sort, and was started with bookbinders. He had no doubt some day we should get paper-making machines attached to printing-presses. Another thing was quite as likely to come, which would be as wonderful, and that is when printing without presses or ink, a whole stack of paper could be printed through at a flash of electricity. We have seen sheets printed in colour by this method, yet we know not what to expect in the future, so rapid are the photographic revolutions.

The CHAIRMAN said he should like to hear the opinion of some artists upon this process, and would call upon Mr. Harry Furniss.

Mr. HARRY FURNISS said he really had nothing to say, but, out of respect for the Chairman, he must endeavour to say something. The sight of the Chairman reminded him that he started when he was fifteen years old to illustrate periodicals, and in those days, living in the country, he was so ignorant of the subject that he imagined every artist had to engrave his own work, and so he set to and taught himself engraving, and for some years engraved all his own work on wood. That method had this advantage, that if he were pushed for time he could easily cut out one or two, or half-a-dozen figures, and put in a few scribbles by reversing the tool, and so get through the work within the specified time. As he only engraved his own work, he did not apply these tricks to the drawing of any other artist. He had heard certain remarks made about the advantage process was to artists, but he really thought it was of more advantage to newspaper proprietors, because but for process they could not have all these wonderful photographs published as they had been in recent years, particularly of late, in connection with the war. They would, no doubt, have had more original work; but what struck him, speaking as an artist, was that the process of reproduction, even the printing had improved so much of late years, but he must say that he considered the artist had not improved in proportion to the improvements in the reproduction of his work. If one took the first volume of *The Graphic* and compared the work there with a volume of the present day, and looked at the work of Fildes, Woods, Gregory, and others, who drew the illustrations of the Franco-German War, and compared that with the work published in the more recent numbers of periodicals representing artistic journalism, he confessed that the later work was not to be compared with that done thirty years ago or more. The reason of this was they were now going in for too much slap-dash work, not only in reproduction, but in the actual preparation. Mr. Hentschel himself had brought rapidity reproduction to such perfection that it did not inte fere with the quality of the work, but it did with t artist, though in another way it had its advantag He remarked years ago, when the Queen visit Ireland, the *Illustrated London News* came out w a picture of the Queen visiting Belfast to open t exhibition, representing her entry into the bay, but it happened, the Queen never went there at having abandoned the visit at the last moment. Tl was because they had, in those days, to prepare t blocks a long time in advance. Now everything tl happened was printed and published and sent of the public in a few hours. Mr. Hentschel had a mentioned that we were rather quicker here than America, but he was not quite certain about th When he was in America he had to go through t frightful ordeal of being interviewed at twelve o'cl by the members of the press, and making a sket and on arriving at the station at half-past two had a paper with his own drawing reproduced a printed, which he thought was a record. There v certainly a great improvement in printing blocks, l this was touching upon technical subjects which wished to avoid. He ought to have said somethi about process, and this reminded him of an Americ story. A little boy was sitting on a doorstep outs a house, and a gentleman who was passing asked w he was sitting there, when all the other little b and girls were inside playing and enjoying themselv The little boy said he was in the same play, l added, "I am the baby, and I ain't born yet." was somewhat in the same position, because he v proud to say that for the last few days he had occ pied the important position of one of the directors Mr. Hentschel's firm, so that next time he was ask to speak about process he might be able to give so information about it; at present he was very ignora

Mr. WALTER BOUTALL said they might all co gratulate themselves upon having heard a very sat factory account of the subject, which to the aver layman was of surpassing interest. His own perience of photographic process and process w generally was about co-extensive with that of M Hentschel, for he was first introduced to the indus in 1872. During that period he had encountere great number of people who wanted to know all ab process work, and he had spent much time in reply to them; but, in future, if he had any inquiries that description he thought the best thing could do would be to refer the questioner to M Hentschel's paper in the *Journal* of the Socie Of course, within the compass of a short pa like this, it was impossible to deal adequately w the history of the subject, and he might be forgi for saying that there were one or two points in wh Mr. Hentschel had inadvertently fallen into error matters of detail; still, taking it as a general popu account of process work, though he had read a listened to a great many he had never met with

ull and satisfactory as that which he had heard : evening.

Ir. R. WILSON regretted that line work had fallen nuch into disuse of late years, and referred to the ellent work which was done in that direction by Hentschel, senior, which, in his opinion, was far erior to the reproductions from half-tone drawings, was much more representative of the artist's work. the present day it seemed to be too much a question apidity and price, but in former times the idea was ier to reproduce the artist's drawing, and the ılts were such that in many cases the artist him- might be proud of them.

ir HENRY TRUEMAN WOOD said there were reat many gentlemen present far more capable ı himself of speaking, but this was a sub- on which people who knew would not talk, ause a great many trade secrets were concerned ch it was not wise to publish. It was, therefore, to amateurs to plunge in where experts feared to d. As an amateur he should like to say that he very much indebted to the professional workers his and other branches of photography for the rmation they were always ready to give if they w that it would be fairly used, and not to their iment. He had a lively recollection of Mr. ıtschel's kindness to him many years ago when was seeking information on this subject, and Hentschel demonstrated to him one of the cesses to which he had just referred. He could orse what had been said by Mr. Boutall as to the er being an extremely fair and liberal record of ıt had been done in the past by Mr. Hentschel's ier and many other workers. Mr. Hentschel rred to Messrs. Leitch as being the first firm to pt process, but he though Mr. Dallas was their lecessor as a professional maker of blocks. remembered very well the first process block ch appeared in the Society of Arts *Journal;* it made by Mr. Dallas. His process was a develop- ıt of the Pretsch reticulated gelatine process; but ısed very soft metal, and when the first blocks were : to the printer, and the printer put them into the ss, the blocks produced a black smudge and e smashed. The result was a triangular duel veen Mr. Dallas, the printer, and himself, but ıtually they got some blocks printed in the *rnal,* which were not very good, but they were the that appeared, and Mr. Dallas was, he believed, first who really produced blocks for com- cial use. He thought Mr. Hentschel had n a little hard on the printers who he said were servative. It was a matter of opinion whether servatism was a good thing, but he was not pre- ed to regard "conservative" as a term of abuse. course they were conservative, but printers ought eceive credit for the way in which they had adapted nselves to the needs of the makers of process :ks, and he thought the improvement had been quite as much in printing as in the manufacture of blocks. The early Meisenbach blocks were quite as good as the ordinary blocks of the present day, but printers could not print them. They put them behind paper backed up with soft blanket, and the whole thing was smudged; for a long time the printer abused the blockmaker, and the blockmaker abused the printer. Ultimately the blockmaker got the best of it, and the printer had to learn to do the work, and the present results were due as much to the printer as to the manufacturer of the blocks. With regard to artists they, like other human beings, were very ungrateful. They took all they could get—very rightly—and then asked for more. No artist worthy of the name but would be ashamed of himself if he did not curse and abuse photography whenever he got the chance, while at the same time making all the use he possibly could of it. The most useful illustration work produced in newspapers was the combined work of the artist and the photographer. The half-tone block, pure and simple, was all very well, but it really was not quite satisfactory as artistic work. But the artist should remember always that he could have his own absolute work carefully reproduced, and had his original sketches for use hereafter. Some few years ago he had the pleasure of meeting Sir John Tenniel about the time when an exhibition was being given by Mr. Du Maurier. Sir John said he had often wished to give an exhibition of his own old drawings, but they had been drawn on wood, and had all been carved and destroyed, so that all the original work was lost for ever. Now the artist had his own original drawing, and could show how much better it was than any work produced from it. He hoped they would have a fine illustration of this when the Exhibition of Modern Illustration, which the Board of Education had undertaken to bring out at South Kensington at the suggestion of the Society of Arts, was opened. He hoped then that they would be able to see the work of artists for the past thirty years in black and white, since their work had been preserved instead of being drawn on wood merely to be destroyed. This subject had been before the Society for a great many years. There had been numerous valuable papers upon it, and anyone who wanted to trace the history of photographic engraving as applied to illustration and the application of photography to printing, ought to begin with the early paper contributed by Mr. Davenport, a respected officer of the Society some thirty years ago, which had been followed by several others, very efficiently brought to a close by the paper they had heard this evening.

The CHAIRMAN, in proposing a vote of thanks to Mr. Hentschel, said he must have taken an immense amount of time and trouble to produce all the slides and photographs which he had shown. He agreed with Mr. Leighton that the name "process" meant nothing at all; but he observed that Mr. Leighton did not propose any substitute which was much to be

desired. Mr. Harry Furniss had referred to the superiority of the old drawings in the *Graphic* to the more modern ones, and he was afraid there was a good deal of truth in what was said. The artists certainly at one period used to take more time and trouble than they did now, and he feared that process had something to do with that fact. Nowadays no drawing was too slight or too rough for Mr. Hentschel or somebody else to tackle it and produce a block to print from. Sir Henry Wood was quite right in referring to the improvement in printing, and he might mention a point which had not been referred to, that a great step had been taken in giving up damp paper and printing on dry paper. To meet the difficulty of the want of depth with these process blocks dry printing had been introduced, which had been a great improvement, and he thought Mr. Hentschel was rather hard on the printers for not being up to date. He believed Sir John Tenniel was the only artist who still stuck to the wood engraving, or his drawings in *Punch* were still engraved on wood. He feared Mr. Hentschel was not quite sympathetic enough to the poor wood engraver. He had painful recollections himself of nibbling away for hours and weeks with a graver to remove white on the block, and to reproduce the black line in relief in order to reproduce facsimile work, and this mechanical drudgery, he was glad to say, had been swept away by process; but there could be no doubt that there were still a great many who admired a fine wood engraving, and there always would be. There was a certain richness and fineness and completeness in a good wood engraving which would be still admired and looked for in spite of all the improvements in process.

The vote of thanks having been carried,

Mr. HENTSCHEL, in reply, said his sympathies were entirely with the wood engraver. He appreciated wood engraving, and in years to come people would treasure up a proof of a wood engraving; but he should like to know who would treasure up a proof of a process block. A good steel engraving, a good lithograph, a mezzotint or a wood engraving would always be valuable, but a proof from a process block would never have the same value in a commercial sense. In a wood engraving the personal element entered very largely into the workman's life, but in a process block there were too many concerned to allow of that individuality of treatment. He was sorry he had forgotten to mention Mr. Dallas, whom he remembered very well as one of the earliest workers in process. He knew printing had improved, but there was still room for improvement, and he saw no reason why English printers should not reach the level of other countries. Mr. Furniss had referred to the rapidity of American work, but he could recall an instance where a fire took place and the block illustrating it was printed before the fire was put out.

Miscellaneous.

COCONUT INDUSTRY IN CEYLON.

Although the coconut palm has been cultiva and has flourished in the island for centuries, products did not, until recently, take as prominen part as might have been expected among expo The explanation is that the palm is slow of grov taking from five to fifteen years, according to character of the soil, to come into bearing, and being in full bearing till ten to twenty-five years. these circumstances, European capital which exp quick returns, such as coffee, cacao, tea, and ca mons yield, has not been largely attracted to it; the experience of European planters in the north and eastern provinces, where only very small pro were derived owing to the difficulties of transp was not such as to encourage investors. What native plantations yielded, lessened by the enorm claims of home consumption, was therefore practic all that reached the market, and was available export and for manufacture at the hands of Bri merchants. Within the past ten to fifteen ye however, there has been an immense developmen cultivation, partly through the growth in knowle and enterprise of the Ceylonese themselves, and pa through the appreciation by Europeans of the that though the returns from coconuts are low, t are surer than from any other industry, and tha an investment there is nothing to equal palm cult tion. The following figures from the exports statis of the island will show at a glance the immense velopment there has been in the coconut industry

	1861.		1898.	
	Cwt.	Value. Rs.	Cwt.	Val Rs
Coconut Oil...........	83,605	1,040,430	435,933	6,684,
,, Poonac......	No	record.	216,620	897,
Copra	27,279	163,680	506,277	6,328
Coir	43,168	308,640	183,931	1,767,
DesiccatedCoconuts	Not es	tablished.	116,433	2,342,
Arrack (gals.)......	393,335	267,870	65,902	153
Coconuts (nuts.)......	—	79,960	12,027,714	541,

The foregoing figures show not only the g advance made by every product of the coconut p since 1861, but also the new uses to which the and its products are put. Thus, in 1861, either t were no exports of poonac (the kernel refuse afte is expressed) or they were so small as not to be w recording. Now they are sent away by thousand hundredweights to various parts of the world, ch Europe, to fatten stock. The trade in desicca coconuts is of very recent growth, and the exp have found a place in the commercial tabular st ments only since 1891; now the kernels of al 40,000,000 nuts are annually deprived of their m

after being sliced in desiccators, and packed in lined boxes are sent to all parts of the world, in-ng France, to be used for confectionery, &c.

ie above items, however, do not exhaust the list e products of the coconut palm sent away from sland. There is a trade in cadjans (or thatch) ats made of the leaf, in coir mats and rugs made ie husk, in laths and rafters made of the wood, in a variety of articles, useful and ornamental, of the shell. Altogether, the value of the rts of the products of the coconut palm cannot r short of 19,000,000 rupees a year, or 30,000,000 s. Nor, again, does this represent in any way value of the coconut industry to the island. It e only great agricultural product whose home umptiom is even larger than the export trade. impossible to state accurately the value of the ucts of the coconut palm used by the people ie country, in the construction of their houses huts, in domestic utensils, in trade implements, ood, in drink, in medicine, in the absolute ssaries of tropical life, in luxuries, but, even the moderate calculation that a family uses ut a day, the 700,000 families of which the),coo people in the island may be said to ist, would consume 383,250,000 nuts. A cal-ion of the exports of last year showed that ly 400,000,000 nuts were sent away in the , in the shell, as oil, and after desiccation; hat the produetion of the island cannot be than 800,000,000 nuts.

is estimated that, including dwelling gardens, it 700,000 acres (280,000 hectares) are planted the coconut palm. This acreage, at 75 trees he acre and 20 nuts to the tree, should yield 0,000,000 nuts; but a large number of trees reserved for toddy drawing, and the distilla-therefrom of the spirit known as arrack. value of the arrack consumed in the island r 1,000,000 gallons) has been computed in cent official paper at Rs. 7,626,067, and of this the Government now receives Rs. 3,000,000 a , or one-eighth of the total revenue, by the of the monopoly of retailing the spirit to iters." The importance, therefore, of the nut industry to the people and to the coun-is beyond controversy; and the growth of industry is steadily maintained. —*Agricultural azine of Colombo.*

)NOMICAL PRODUCTION OF WATER GAS.

'ater gas, composed of two parts, nearly equal, of onic oxide and hydrogen, is consequently of easy bustion; but unfortunately its production is costly. obtaining this gas under more economical con-ns Herr Carlo Dellwik has devised a method led into two periods (as mentioned in the *Jern-contorets Annaler*) (1) a period of blowing hot air under the grate of the gas-producer for ten minutes, in order to raise the charge of coke to a high temperature; and (2) a period of introducing steam into the gas-producer during the time necessary for maintaining the coke at a sufficiently high temperature for permitting decom-position of the steam, *i.e.*, four or five minutes. During the first period the appliance works like a Siemens gas-producer, and permits the disengagement of a carbonic oxide and nitrogen compound, which is sub-sequently utilised, generally for heating the air and producing the necessary steam. Experimental trials have been made at Warstein, Westphalia, with Essen gas-coke containing 87·56 per cent. of carbon; and 2·56 cubic metres (90 cubic feet) of water gas were obtained per kilogramme (2·2 lb.) of coke, which figure becomes 2·13 cubic metres (75 cubic feet) if the coke used for heating the air and furnishing the steam be taken into account. By this method more than double the usual quantity of gas, having a density of 0·5365 and a calorific power of 4089 calories per kilogramme (7360 British Thermal Units per lb.) is obtained, consisting of hydrogen 0·75, nitrogen 3·93, and various other gases 0·88 per cent.

General Notes.

FALMOUTH EXHIBITION.—The Royal Cornwall Polytechnic Society will hold its sixty-seventh exhibition from August 21st to 25th, 1900. Medals, prizes, and certificates will be given for exhibits under the following heads:—Wood-carving, metal-work, pottery, printing, book-binding, leather-work, lace-making, art needlework, design, furniture, wall-hangings, &c.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

APRIL 25.—In consequence of the ill-health of Mr. Batalha Reis the meeting announced for this date will not be held.

MAY 2.—"Some Unfamiliar Masterpieces of the Italian School." By Miss HALSEY.

MAY 9.—"Improvement of our Roads." By A. MORESBY WHITE. SIR JOHN WOLFE BARRY, K.C.B., Chairman of the Council, will preside.

MAY 16.—"A National Repository for Science and Art." By PROF. FLINDERS PETRIE.

MAY 23.—"Salmon Legislation." By J. WILLIS-BUND.

Indian Section.

Thursday afternoons at 4.30 o'clock:—

April 26.—Sir John Scott's paper announced for this date is unavoidably postponed until May 24th.

May 17.—The Industrial Development of India." By Jervoise Athelstane Baines, C.S.I.

Applied Art Section.

Tuesday evenings at 8 o'clock:—

April 24.—In consequence of the illness of Mr. E. F. Strange his paper announced for this date is unavoidably postponed.

May 8.—"Art Metal Work." By Nelson Dawson. Henry H. Cunynghame, C.B., will preside.

Cantor Lectures.

Monday evenings at 8 o'clock:—

Prof. Vivian B. Lewes, "The Incandescent Gas Mantle and its Use." Three Lectures.

Lecture I.—May 7.

The History of Incandescent Gas Lighting.—The discoveries that led to the mantles of to-day—The oxides suitable for mantle-making and their preparation—The services of thoria and ceria, and the methods adopted for their extraction.

Lecture II.—May 14.

The Manufacture of the Incandescent Mantle, and the Influence of the Process employed on the Life of the Mantle.—Manufacture by impregnation of vegetable fibres, and by moulding the oxides into thread—The recent advances in mantle manufacture—The theory of the incandescent mantle, and the causes which lead to luminosity.

Lecture III.—May 21.

The Gas Burners employed in Incandescent Lighting.—The theory of the Bunsen burner—The adaption of the Bunsen burner to the incandescent mantle—Modern burners and their aims—The effect of the chimney — Chimneyless burners — High - pressure burners—The influence of the quality of the gas on the conditions of burning—The use of water-gas in incandescent mantle burners.

MEETINGS FOR THE ENSUING WEEK.

Monday, April 23...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Special Meeting. Sir William H. Preece, "The Relations between Electricity and Engineering." (James Forrest lecture.)

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Killingworth Hedges, "The Protection of Public Buildings against Lightning."

Medical, 11, Chandos-street, W., 8 p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 8 p

Tuesday, April 24...Royal Institution, Albemarle-s square, W., $8\frac{1}{2}$ p.m. Dr. H. R. Mill, "Stud British Geography." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square $8\frac{1}{2}$ p.m.

Civil Engineers, 25, Great George-street, S.V p.m. Sir William H. Preece, "The Rela between Electricity and Engineering." (Repe of the James Forrest lecture.) 8 p.m. Ar General Meeting.

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. H. Bence Jones, "The Consumption of Alco Beverages."

Photographic, 66, Russell-square, W.C., 8 (Technical Meeting.) Mr. J. Bridges Lee, " Latest Developments of Metrophotography."

Anthropological, 3, Hanover-square, W., $8\frac{1}{2}$ p.n

Wednesday, April 25...Geological, Burlington-house, 8 p.m. 1. Dr. Charles Callaway, "Longmyn Inliers at Old Radnor and Huntley (Gloucest 2. Prof. H. G. Seeley, "A Complete Skelet an Anomodont Reptile from the Bunter Sands of Riechen, near Basel, giving new Evidence o Relation of the Anomodontia to the Monotrem

Royal Society of Literature, 20, Hanover-sq W., $4\frac{1}{2}$ p.m. Annual General Meeting.

Mining and Metallurgy, Geological Mus Jermyn-street, S.W., 8 p.m. 1. Dr. T. K Rose, "The Electrical Precipitation of Gol Amalgamated Copper Plates." 2. Mr. J Chalmers, "Notes on the Namaqualand Co District." 3. Mr. Walter McDermott, "A I on Hand Concentration Tests." 4. Mr. C. Rolker, "Notes on the Elmore Concentra Process."

Thursday, April 26.. Society for the Encouragement of Arts, 9, Conduit-street, W., 8 p.m. Mr. W. G Townsend, "Some Ancient Embroideries."

Royal Institution, Albemarle-street, W., 3 Prof. Dewar, "A Century of Chemistry in Royal Institution." (Lecture I.)

Electrical Engineers, 25, Great George-street, S. 8 p.m. Prof. G. Forbes, "The Electric Tr mission of Power."

Numismatic, 22, Albemarle-street, W., 7 p.m.

Mechanical Engineers, Storey's-gate, St. Jam park, S.W., 8 p.m. Professor H. S. Hele-Sh "Road Locomotion."

Friday, April 27...Royal Institution, Albemarle-str W., 8 p.m. Weekly Meeting, 9 p.m. Lord Kel "Nineteenth Century Clouds over the Dynam Theory of Heat and Light."

Clinical, 20, Hanover-square, W., $8\frac{1}{2}$ p.m.

Physical, 8 p.m., in the Solar Physics Observat Exhibition-road, South Kensington, by invita of Sir J. Norman Lockyer. 1. "A short acc of the Physical Problems now being investigate the Solar Physics Observatory, and their As nomical applications." By Sir Norman Lock 2. Weather permitting, the 36-inch, 10-inch, 9-inch telescopes will be used for the observat and photography of celestial objects and t spectra. The Apps-Spottiswoode coil and 2 Rowland grating will also be in operation.

Saturday, April 28...Botanic, Inner Circle, Regent's-p N.W., $3\frac{3}{4}$ p.m.

Royal Institution, Albemarle-street, W., 3 p Professor Stanley Lane-Poole, "Egypt in Middle Ages." (Lecture I.)

Journal of the Society of Arts,

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FRIDAY, APRIL 27, 1900.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXHIBITION OF MODERN ILLUSTRATION.

The Board of Education have decided, at ıe suggestion of the Council of the Society of rts, to hold during the autumn an Exhibition : Modern Illustration in the Victoria and lbert Museum, South Kensington.

The Exhibition will consist of works in black ıd white intended for book, periodical, and ewspaper illustrations, and will be confined ılely to modern examples of typographical ork executed since 1860. This limit covers ıe time during which photography has been vailable for reproductive purposes, and during hich consequently the original drawings ave been preserved, and are available for xhibition.

The Board will be assisted in the selection ıd arrangement of the drawings by an ıfluential committee, with some additional ıembers, which had already been organised y the Society of Arts.

It is proposed that the Exhibition shall be pened about November 1st and remain open r four months. The drawings will have to be nt not later than October 1st.

The first meeting of the committee (Sir ımes Linton in the chair) was held on londay, 9th inst., when an executive committee was appointed.

Any further information will be furnished ı application to the Secretary, Board of ducation, South Kensington, S.W., to whom l communications on the subject should be ldressed.

EXAMINATIONS.

The Council have determined to add to the xisting Examinations of the Society an Upper and a Lower grade, and to revive the system carried on from 1876 to 1879 inclusive, of awarding a certificate in Commercial Knowledge to candidates who have passed in a certain specified number of subjects in each grade. This certificate will be additional to the certificates granted for separate subjects. The examination in the Preliminary or Junior grade will be adapted to the attainments of the continuation school pupil, who, after reaching Standard VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. The examination in the Secondary or Intermediate grade, will be of the same standard as that of the present examinations of the Society. The examination in the Final or Upper grade will be adapted to the attainments of youths who have gone through a course of two or three years at a higher commercial school, college, or special institution, and are engaged in, or are qualifying for the higher branches of commercial life. Further particulars of the proposed addition to the examination system will be published in due course.

PRACTICAL EXAMINATIONS IN MUSIC.

The Practical Examinations in Vocal and Instrumental Music will be conducted by Mr. John Farmer, Balliol College, Oxford, and Director of the Harrow Music School, Examiner, and Mr. Ernest Walker, M.A., Mus.Doc., Oxon, and Mr. Burnham Horner, Assistant Examiners, at the House of the Society, and will commence on Monday, 25th June.

The last day for receiving applications is Friday, 11th May.

Particulars can be obtained on application to the Secretary.

COVERS FOR JOURNAL.

For the convenience of Members wishing to bind their volumes of the *Journal*, cloth covers will be supplied post free for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready, and can be obtained by Members on application to the Secretary.

Miscellaneous.

THOMAS GRIGNION, CLOCKMAKER.

In the Society's meeting room there is a large time-piece in a mahogany case with this inscription upon the front:—"The gift of Mr. Thomas Grignion, A.D. 1760."

Grignion was a man of considerable note in his day, and this clock, which is perfectly trustworthy now after an existence of one hundred and forty years,* holds a position of some importance in the history of horology. Grignion lived in Russell-street, Covent Garden, and was elected a member of the Society on May 14, 1755, a year after its foundation. He died on April 4, 1784, aged 71, and is described in Rees's Cyclopædia (art. "Clock") as "a good mathematician as well as an excellent workman." "He was an intimate friend of James Ferguson and other scientific men of his time." His elder son, Thomas Grignion, junr. (who was in his father's business, and is described as a watchmaker), received a premium in 1761 from the Society of Arts for an Indian ink drawing, after Rademaeker. The younger son, Charles Grignion, who is described as an historical and portrait painter, received a premium in 1765 for a drawing in chalks of a moonlight scene, and in 1768 a silver palette for a copy of the "Scourging Man," by Dominichino.

The Grignion family were for many years influential inhabitants of the parish of St. Paul's, Covent Garden. The younger Thomas Grignion made public claim for acknowledgment of his father's improvements in clock and watch making and for Richard Harris's invention and construction of the first long pendulum clock in Europe. An engraved plate, dated "Great Russell-street, Dec. 21, 1798," was prepared by him and placed in the vestry of St. Paul's Church, Covent Garden. The inscription was as follows: "The (new) turret clock and bells of this church were made A.D. 1797 by Thomas Grignion, of Great Russell-street, Covent Garden, the son and successor of Thomas Grignion, who A.D. 1740 brought to perfection what the celebrated Tompion and Graham never effected—viz., the horizontal principle in watches and the dead-beat in clocks, which dead-beat is a part of the mechanism of the turret clock. Thomas Grignion, senior, made the timepiece in the pediment at the east end of this parish church destroyed by fire A.D. 1795. The clock fixed in the turret of the said (late) church was the first long pendulum clock in Europe, invented and made by Richard Harris, of London, A.D. 1641, although the honour of the invention was assumed by Vincenzio Galilei A.D. 1649 and also by Huygens in 1657. This plate is here affixed by Thomas Grignion, of this parish, the son of the above Thomas Grignion, as a true memorial of praise to those two skilful mechanicians (his father and Richard Harris), wh to the honour of England embodied their ideas i substantial forms that are most useful to mankind."

* An occasion when the clock refused to go was during the period when it was synchronised for Greenwich time.

The statement here made as to Harris's pendulu clock is founded on a MS. note by the elder Thoma Grignion, in a copy of Richard Waller's translatio of "Essayes of Natural Experiments made in th Academia del Cimento, 1684."

This note, which is quoted in Rees's Cyclopædi reads as follows:—"The great clock belonging t Covent Garden has a long pendulum, and was mad by Richard Harris of London, in the year 1641 which was eight years before Vincentio Galilei pu his father's observations into practice, as appears b the date 1649.

"The ingenious Mr. Huygens applied the pendulu to a clock in the year 1657, and attributed the inven tion to himself, which created a dispute between hi and Vincent Galileo; this last affirming that he ha put it in practice in 1649; and the reason of Richar Harris's not appearing (which would have decided th controversy) in all probability was that he being onl a private workman was entirely unacquainted wit any dispute which might happen between Vincen Galileo and Mr. Huygens; or he might be dea before the dispute arose, it being sixteen years aft he made the said Church clock."

In the vestry of St. Paul's Covent Garden, there i another clock of historical interest. This was mad by Thomas Tompion, and repaired by the younge Thomas Grignion in 1798.

Information respecting the Society's clock is foun in the minutes of the meetings. On May 10, 175 "it being ordered that a dial should be purchased fo the use of the Society, Mr. Grignion offered to pre sent the Society with one which was accepted o The thanks of the Society were unanimously returne to Mr. Grignion for his above generous offer."

On February 20, 1760, "a letter from Mr. Thoma Grignion was read, wherein he mentions that he ha delivered and begs the Society's acceptance of a time piece in lieu of the dial he had promised to th Society. Ordered that the thanks of the Society b given to Mr. Grignion, who was declared a perpetu member without further contribution."

This letter is still in the possession of the Societ and reads as follows:—

"SIR,—Please to acquaint our worthy President Vice-Presidents, and Members of our laudabl Society, the Great Room being complete, I hav delivered and beg their acceptance of a Timepiece i lieu of the Dial which I had promised to give, fo as I found the building of a new room would giv me time and opportunity of presenting them wit something more elaborate and correct than common I was very glad to embrace this means of convincin them of my utmost esteem and regard. And as th inventions in our art have been nearly exhausted b the many ingenious men who have practised it befor me, as Tompion, Quare, Graham, &c., I pretend t no more than some small improvements in the piec

present them with. They are two. First, by the ddition of wheels I have increased the numbers ithout increasing the vibrations, and thereby gain a ery considerable power; and also a more smooth nd uniform motion than common. Secondly, I ave in this piece reduced the Dead-beat scapement made use of with such success by the late ingenious Ir. Graham) to an universal and easy theory for wag-wheels of all dimensions, and which may enable vorkmen, though unskilled in the mathematicks, to xecute this most difficult part of the machine with ll possible advantage, only with a rule and compass, nd which when known I hope will not be unacceptble to those of our art, having thrown in the mite of vhich I beg their acceptance, permit me with the varmest wishes for the prosperity of this Society, to ubscribe myself, my Lords and Gentlemen, your nost respectfull humble servant,

"THOS. GRIGNION."

"From a regard for truth, I must notice that the ddition of wheels mentioned above was first sugested to me many years ago by his Grace the Duke f Argyll, to whose knowledge in this art I have many bligations, and I carried it into execution for his race in a great watch made for himself five or six ears ago."

The Great Room mentioned in this letter was not he present meeting room, but was in the Society's ouse in the Strand, which stood at the corner of Beaufort-buildings. Possession was not taken of the resent building in the Adelphi (which was erected or the Society by the Brothers Adam) until the year 774.

The Duke of Argyll here referred to was Archibald Campbell, third Duke (1682-1761), who held so nfluential a position in the management of Scottish ffairs as to receive the name of the King of Scotand. In his life, in the Dictionary of National Biography, he is described as a man of "wide and aried accomplishments," but there is no notice of his ractical knowledge of the art of clockmaking.

In the article "Clock," in Rees's Cyclopædia 1819), special notice is made of the Society's clock. After a reference to Grignion's claim for the priority of Harris's pendulum clock, the writer adds:—"He was one of the first members of the Society of Arts in London, to which Society he presented a egulator in the year 1759 [should be 1760], which is yet in one of the rooms of the Adelphi, and which has the improved dead-beat escapement, and very high numbers in the wheel-work to avoid friction, which was another idea of his own. The peculiar properties of this clock, however, seem not to have been noticed by, or even, perhaps, known to any of the present members of that numerous Society, so as to become an object of particular attention. Mr. Grignion, notwithstanding, assures us that it will keep the same time, whether its maintaining power be four or twelve pounds, which property he ascribes principally to his father's improvement of Graham's dead-beat escapement."

BRITISH COAL PRODUCTION.

An important article on the present coal famine, contributed by a correspondent, has appeared in *The Times*, and the following particulars are taken from this article:—

A coal famine, in the absolute and unqualified sense of the term, is as unlikely, and perhaps as impossible, as an absolute food famine. Supplies of coal will always be available, just as we may always expect to command supplies of food. But the word famine has both a relative and an absolute meaning; and we are relatively coming near to the stage of famine when coal has become so scarce that those who require large supplies have much difficulty in procuring them, when the widely-ramified branches of national industry suffer consequent loss and inconvenience, and when the cost of fuel has been forced up to a point that compels the ordinary citizen to be parsimonious in its use. Such a stage of relative scarcity and dearness has been reached within the last few months; and the curious and unique feature of the business is that it has been reached almost simultaneously in many different countries. England in this respect is neither worse nor better off than Germany, France, Belgium, Russia, Austria, Spain, and other European countries; while even the United States, which has hardly ever before known what it is to be without cheap and abundant supplies of fuel, is now, from this point of view, more or less sharing in the universal complaint that coal is relatively scarce and dear.

Having, at one time or another, visited and examined the principal coalfields of the United States, Germany, France, Belgium, Bohemia, and Hungary, as well as those of the United Kingdom, and having given to the economic conditions of the coal industry a large amount of my attention for more than a quarter of a century, I have naturally been struck by the very exceptional character of the recent and existing situation in the coal industry. The most prominent feature of that situation is the world-wide demand for increased supplies, and the consequent efforts that are being made in all coal-producing countries alike, to bring the supplies abreast of the extraordinary demand. No country on the face of the earth is now in possession of as cheap supplies of fuel as formerly. In the great majority of cases, the last twelve months have witnessed advances of price ranging from 10 to 100 per cent.; but, whether it be China, Japan, Australasia, Continental Europe, North America, or Great Britain, higher values for fuel have everywhere prevailed.

The proximate causes of the recent scarcity and present high cost of fuel all over the world are, in my opinion, the following:—

1. The increase in the make of iron and steel, which has increased the consumption of fuel, within the three years ended with 1899, by probably quite forty millions of tons.

2. The increased requirements of the world's rail-

ways, which within the same period have had to face an enormous increase of business, involving a corresponding increase of coal consumption.

3. The growth of the world's mercantile marine, responding to the increase of commercial operations, which probably represents an increase of 15 to 20 per cent. on any former period, and a similarly larger demand for coal.

4. The almost unequalled prosperity of all manufacturing indnstries, and the demands thereby entailed on coal-producing nations.

5. The more general diffusion of wealth, and the greater prosperity of whole communities, which have led to a larger consumption of coal for domestic and other purposes.

A very perfunctory examination of this analysis of causes is sufficient to show that they are of world-wide application, although no doubt in some countries they will be much more generally active than in others. One of the oldest writers on the principles of political economy has written that all the world, as to trade, is like a single nation. If this remark applies with special emphasis to any particular trade, it must be the trade in coal, for British coal is now supplied to the extent of over fifty million tons a year, to almost every country in the world, and any rise of cost at the pit, or increase in the rates of freight, is at once felt by the remotest markets.

But the threatened coal famine has another unique feature in following as it does a period of the greatest expansion of mineral, and especially of coal, resources that has ever been known. The extent of this expansion may be estimated from the following comparison:—

QUANTITIES OF COAL RAISED IN THE PRINCIPAL COAL-PRODUCING COUNTRIES IN 1869 AND IN 1899.

Country.	1869.	1899.*
	1=1,000 tons.	1=1,000 tons.
United Kingdom	102,948	220,000
United States................	28,258	205,000
Germany†	25,704	130,000
France†	13,330	35,000
Belgium	12,298	24,000
Austria†	3,600	15,000
Russia	510	13,500
Colonies and India	750	15,000
Japan and other countries	500	6,000
Totals	187,898	663,000

* The figures for 1899 are mostly estimated, but within very narrow margins of error, taking the world's output as a whole.

† The figures recorded for these countries include considerable quantities of lignite and brown coal.

Within the same period the consumption of petrc leum and natural gas for calorific uses has mad corresponding progress, equal, approximately, to a addition of at least another 50 or 60 million tons t the annual fuel resources of the world.

From this table it appears that during the 30 year ended 1899 the fuel (coal) output of the world ir creased by 475 millions of tons, or 252 per cent. Th curious thing is that despite the enormous advanc the demand for coal in 1899 was greater, and th apparent danger of a coal famine more real tha at any period excepting in the years 1873-74. Le us further see to what this enormous increase i the world's consumption of coal is mainly due.

In the first place, as already stated, there can b little doubt that it is attributable to the increase demands of the world's industrial operations, an more especially of the iron industry. Since 186 the world's output of pig iron as risen from abou ten million to over 40 million tons. This alone woul mean an increased consumption of coal, as coal, t the extent of between 45 and 50 million tons. Bu in working up this pig iron into manufactures—rails plates, structural iron and steel, wire, cutlery, tools and implements and machinery—probably a furthe 100 million tons of fuel would be consumed, so tha over 30 per cent. of the total increase is directl attributable to the iron trade and collatera industries.

In the next place, as we have seen, transportatio in its various forms is responsible for a great part o the increase. The shipping trade of Great Britai alone absorbs nearly 20 million tons of fuel annually That of the world at large will probably consum three times that quantity; and, after due allowanc has been made for the improvements which hav enabled steamers to be worked with quite one-hal of their former consumption of coal, the vast increas in the relative proportion of steam tonnage, and i the work done by that tonnage, will in all probabilit have called for nearly twice the quantity of fuel consumed by the mercantile marine of 30 years ago. Ir other words, if the world's coal consumption unde this head is now 60 million tons a year, this is likel to be 30 million tons more than the quantity consumed in 1869. We know definitely that, in the case of the United Kingdom, the increased consumptior in the interval has exceeded 100 per cent.

The coal consumption on railways is a very large and increasing item. On the 25,000 miles of line constructed in Great Britain, the annual coal consumption is now computed at about 10 million tons. There are at present over 465,000 miles of railways ir operation throughout the world, and, if they are assumed to average the ascertained British consumption of fuel, the total consumption of coal ir railway operations would be something like 18c million tons a year. From this figure, however, very large deductions have to be made in respect of lines with little traffic and lines that burn other sorts o fuel, such as wood and petroleum; so that, on the

whole, the railway consumption of coal fuel will robably be quite 50 million tons under the figure btained by adopting British practice as a basis. Even so, however, the total coal consumed on the world's railways would come out at 130 million tons, nd of this quantity probably one-half has been added luring the period under review.

We have now accounted for 245 million tons, or over 50 per cent., of the total increase in the world's onsumption of coal during the last 30 years. As with he iron industry, so with general manufactures. As vith steam shipping and railways, so with domestic equirements, the gas industry, naval needs, and the nany other elements that make up the sum total of he uses of fuel. During these 30 years the world's population has increased enormously—probably to the xtent of quite 200 millions—and this alone would epresent a vast coal consumption, if the general home consumption of coal-using countries be taken it even one-fourth the British standard, which is 3·8 ons per head per annum.

When one examines the main causes of the increase of coal consumption in the past, it is at once apparent that the phenomena producing the results in question are of a more or less permanent character. Hence the increase in the consumption of coal is likely to continue in the future, although whether in a diminishing or in an accelerated ratio no one can with confidence predict. Railways will continue to be built, commerce will continue to extend, iron and steel—the handmaidens of material civilisation—will be produced in larger quantities, population will continue to grow all over the world, and the demand for more coal will follow.

We may now proceed, with advantage, to discuss the special circumstances of the coal trade situation, so far as the United Kingdom is concerned. That situation has a number of distinguishing and characteristic features. Perhaps the most prominent of these is the enormous extent of our export trade, which is more than three times as great as that of Germany, the next most important coal-exporting nation, and fifteen times as much as that of the United States, which is the next largest coal-producing nation after our own. Another distinguishing feature of the British coal industry is that our supplies are in many directions threatened with relatively near exhaustion. In Lanarkshire—the most important of the coalfields of Scotland and the one of all others on which the great manufacturing industry of Glasgow mainly depends—in South Staffordshire, in the Forest of Dean, in some parts of Durham and Northumberland, and elsewhere the available supplies of coal are being so rapidly depleted that more or less serious exhaustion will have to be faced within the next twenty, and in some cases —as in that of the cheap coal of Lanarkshire—within the next ten, years.

The average increase of value in the coal trade of Great Britain over the year 1899 is difficult to compute. In some descriptions of coal it has been much more considerable than in others. It has perhaps been greatest of all, strangely enough, in what are ordinarily regarded as the most worthless varieties—namely, smudge or "duff," which in some previous years have been sold at 1s. per ton, or even less, but which within the last few months have sold in large quantities for 5s. to 6s. 6d. per ton, according to the locality and the purposes to which it was to be applied. A very good test of the difference of value is that supplied by the coal export returns. If we go back to the four years ended 1888, we find that the average declared value of our coal exports in that period was only 8s. 5d. per ton. In the four years ended 1898 the average was about 9s. 3d. per ton. But for the last six months the average declared value of our coal exports was not less than 13s. 6d. per ton, which is an advance of 4s. 3d. on the average value of the corresponding exports for the four years ended in 1898.

But the export coal values, after all, apply to only some 60 million tons at the most, including coke and the coal shipped for steamers in the foreign trade. If the two last-named items are deducted, the export values apply to less than 50 millions, out of a total computed output of about 220 millions. There would, therefore, remain 170 million tons to be dealt with, as representing home consumption, or, rather, home consumption *plus* foreign shipping. This remainder is divisible into coking, manufacturing, household, gas, and steam fuel. In regard to all descriptions alike there has been a material rise of values though not to the same extent. Coking coal has perhaps felt the impulse of heavy demands more than any other description, primarily because of the revival of our iron and kindred industries, but also because there has been unusal pressure on the part of foreign buyers, especially France and Germany. The usual price of coke at the ovens in Durham over a series of years has been about 9s. per ton. For a considerable part of last year, and up to the present time, the value of good coke at the ovens has been 22s. to 25s. per ton. So far as household coal is concerned, the average value in the London market for the four years ending 1897 was 15s. 2d. per ton, whilst the corresponding average since midsummer of 1899 has been about 22s. per ton. At the greatest centre of the steam coal trade—namely, Cardiff—the average official price of that variety of fuel f.o.b. for the two years ended 1897 was 9s. 7½d. per ton, whereas for some months past the best qualities of that fuel have been quoted at 20s. to 23s. per ton, and some sales have been recorded as high as 26s. Manufacturing coal, as the owners of iron, steel, shipbuilding, engineering, and other works know to their cost, has gone up fully 4s. to 6s. per ton according to locality and description, while gas coal, of which the supply is far from unlimited, has followed a similar movement. On the whole, therefore, we are not likely to be far wrong in estimating that for the eight months ended the 1st of March this year there has been an advance of

5s. to 6s. per ton all round in the realised value of coal where supplies were free for sale, as in view of the previous upward movement they would generally be, so that coalowners should have had a difference of fully 5s. per ton to dispose of over and above the profits realised previously.

It was inevitable that the prospect of large profits should tempt coal-owners and capitalists to adopt energetic measures to bring about an increase of coal production. Fom the various projects of this character that have come to my knowledge—including not only the opening out of new collieries, but the re-opening of old ones, and the sinkings made to other seams in existing pits—I am of opinion that within the last 15 months provision has been made for adding quite 20 million tons a year to the coal output of the United Kingdom; and, if the same average annual output per *employé* as that of the period 1894-97 is assumed, the increased resources of production will probably be considerably more.

The throwing of this large additional volume of coal on the market is likely to convert the present relative scarcity into an absolute glut. The question is—when? On this point one cannot profess to be any wiser than the man in the street. No one knows what the coalminers may do, and they are virtually the masters of the situation. If they work steadily, and take only an average number of holidays, we may look for greater abundance as a proximate event. If they adopt organised restriction, as they did in 1873-74, and have several times done since, they may succeed in keeping up prices for a considerable time to come. In these matters the attitude of labour—which is generally the dark horse—counts for much. But in any event, no relief worth speaking of is to be expected from foreign countries. We have already seen that their position is quite as strained as our own.

MOTOR CAR EXHIBITION.

An exhibition of motor vehicles was held last week at the Agricultural-hall, Islington, and the following notice of some of the exhibits is from the *Engineer*:—"Although the number of vehicles on view is not so great as might have been anticipated, the show generally may be considered fairly representative of the state of the industry. All classes of carriages are represented, but those propelled by internal combustion engines of course predominate. There are also carriages propelled by electricity and steam. In the last-named category the public have an opportunity of familiarising themselves with two new types of light steam vehicles which have recently been introduced from America. It is a source of gratification to find that a steam carriage can be built which can compare favourably in point of weight, appearance, and price, with many of the carriages propelled by internal combustion engines using the light oils. We refer especially to the American carriage, built by the Locomobile Company, of Sussex-place, South Kensingto This is an extremely neat machine, of the Americ buggy pattern, with pneumatic-tyred cycle whee and weighing under 5 cwt. In this machine, steam generated in a vertical fire-tube boiler, containi 44 square feet of heating surface, by means vaporised petrol. The supply of oil is carried in copper tank having a capacity of three gallons, a one gallon is said to be sufficient to run the carria from ten to thirty miles, varying according to charact of roads and conditions. The water tank has a cap city of seventeen gallons. The water is supplied the boiler by a pump connected up in a by-pa system, thereby giving the driver perfect control of tl supply. The engine is of the double cylinder, sli valve, reversible pattern, with dust-proof ball bearing and drives the rear axle by means of chain gearin The lever for starting and stopping, and the reversin lever are conveniently placed on the right-hand side the seat, giving the operator instant control of th carriage, and permitting it to run either forward backward. The rear axle is connected in the cent by a compensating gear, which permits one wheel t move more rapidly than the other in making a tur The front wheels are connected by a swivel join attached to the steering gear. The oil fuel is mair tained under air pressure, and is burnt in a number small jets. The burners are automatically regulate by the steam pressure, and the attendant has only t keep an eye upon the water gauge, which is placed i a convenient position. The steam cylinders are $2\frac{1}{2}$ in diameter by 4 in. stroke, and running at a speed from 300 to 400 revolutions per minute, with a stea pressure of 150 lb., develop from 4 to 5 horse-powe These carriages are supplied with or without con densers. Compared with the oil carriages, the work ing mechanism of these cars appears remarkabl simple, the engine and boiler being stowed awa under the seat. Moreover, there is no noisy an cumbersome variable speed gear required, the speed o the engine being regulated by the valve gear. Pro vided that the interior of the boiler is accessible fo cleaning purposes, and sufficiently strong to stand th rough handling and stresses set up by expansion an contraction due to the fluctuations of steam pressur which must occur in carriages of this type, ther appears to be no reason why such a vehicle should no at least be as satisfactory as most of its oil-propelle contemporaries, in which a very large percentage o the power generated is absorbed in overcoming th friction in the transmission gear.

Another specimen of steam vehicle is exhibited b the Brown-Whitney Company. The arrangement o the motor mechanism in this carriage is somewha similar to that just described, but the car bod partakes more of the phæton type. The steam i generated in a vertical steel boiler fired with gasifie petrol, the supply of which is controlled by an auto matic governor actuated by the steam pressure. The burner is divided into three pieces, the torch and the two halves of the main burner. These latter the

ator closes entirely when the steam pressure ies its limit, leaving the torch burning strongly, at it cannot be blown out, and yet is in itself in- ient to raise the steam pressure. The water is lied to the boiler by a pump worked by the ie when running. The water supply is carried at ear of the car, and the water on its way to the r is heated by passing through a coil in the fire- The petrol reservoir is contained within the r tank. The engine is of the steam-jacketed, le-cylinder type, and has a special reversing gear. engine drives directly on to the back axle by a i, and all variations of speed are produced by ng the speed of the engine, which runs at a pro- onate speed to the car. The framework of the age is of steel tubing, in two parts, viz., the upper lower. The latter has attached to it the back and the front attachment carrying the steering ls and the swivelling arrangement, which allows vheels to take an uneven road without racking rame. The upper frame is attached to the lower rings, and upon this is carried the engine and r, and also car body. The exhaust can be made ible by turning it into the water tank. The steer- speed-controlling, and reversing motions are rned by a single handle. The wheels are of the pattern, with metallic spokes, and are fitted pneumatic tyres. Both of the above carriages aking part in the 1,000 miles trial of the Auto- ile Club.

ie Thornycroft Steam Wagon Company, Limited, wick, is the sole representative of the heavy type eam vehicle, and show a 3-ton steam wagon with i trailer constructed with entirely closed-in bodies he carriage of paper. The motive mechanism of wagon is substantially similar to that described notice of the Liverpool heavy vehicle trials last ner.

this notice we do not intend to refer at any th to the carriages propelled by light oils, except tate that there is a considerable improvement eable all round in their design.

THE INDIGO INDUSTRY.

ie following letter by Dr. Armstrong, F.R.S., ared in the *Times* on the 24th instant:—

Sir,—It will be remembered that the appearance our columns, in October last, of an important le calling attention to the way in which the indigo stry in Bengal was threatened, in consequence of manufacture of indigo artificially in Germany, led ie publication of a number of letters in which the ect was discussed from various points of view. ng others I urged that the matter must be treated usly—that planters must, without delay, put their e in order and seek in every way to improve the vation of the plant, and the extraction of the go from it. In concluding, I said:—'It would be interesting to know whether a single competent chemist is at present engaged in studying the subject, and whether the Indian Government has in any way had its attention directed to the importance of scientific aid being given to the industry.'

"The answer I received privately was that Mr. Christopher Rawson had visited India and spent some time there on behalf of the Indigo Planters' Association.

"On Thursday last Mr. Rawson read a paper on indigo before the Indian Section of the Society of Arts; but this was nothing more than a lengthy statement of familiar facts. The real question of importance at the moment was entirely shirked. We learnt that 'Blue cloths found on Egyptian mummies 5,000 years old have been found to have been dyed with indigo,' and that 'the Behar planters had formed a volunteer cavalry corps which had enabled the Government to do away with the cavalry regiment previously stationed at Behar.' Photographs of this corps were even exhibited to us on the screen.

"No word was said, however, as to what has been done during the past five or is likely to be done during the coming five years; what steps have been taken to organise an effective opposition to the German manufacturers.

"Mr. Rawson expressed a pious opinion that the competition would be successfully met. He further told us that if artificial indigo can be produced in large quantities at such a price as to render indigo planting altogether unprofitable it can only be regarded by Englishmen as a national calamity. But what will the Germans care how we regard the matter if they can but secure the field? No altruistic considerations will be allowed to paralyse their efforts. The very importance of indigo—we were told it is worth between three and four millions annually to India—is an element of greatest danger, as it makes the stake all the more worth playing for. It is clear that it is so regarded; in fact, just before attending the lecture I heard it stated—and I have no reason to doubt the accuracy of the statement—that the Badische Company have already spent half a million on their new plant for the manufacture of indigo. Cautious business men do not operate on this scale without reason.

"Have we spent £5,000 in the endeavour to set our Indian indigo house in order?

"There is no reason to doubt Mr. Rawson's ability, but one swallow does not make a summer. The problem to be solved is one of great complexity—the conditions of cultivation, as well as those of extracting the dye, have to be exhaustively studied; both time and genius must be devoted to the inquiry, which is one needing scientific skill of the very highest order.

"Surely, sir, if the Indian planters are calling on the English Government to foster their industry, the English public have the right to ask, What are the planters doing to protect themselves? Are they taking any really effective measures beyond forming a volunteer cavalry corps?

"The manufacture of indigo artificially would in some degree be less of a calamity, perhaps, if there were any prospect of our being able to do our fair share of the work; but unfortunately we seem to have muddled away all chance of that. Yet it is a striking fact that the coal tar colour industry and the alizarin industry were both started here, that they flourished here for a time, and that the man who founded them both—Perkin—is also practically the inventor of the process of manufacturing what was for a considerable time the all-important material in preparing artificial indigo, viz., cinnamic acid. We are, therefore, not altogether devoid of the necessary inventive power. The breakdown is on the practical side. Yet we dub ourselves a practical nation! Our failure to properly appreciate and encourage scientific work, and to apply it in our industries to anything like the proper extent, is too terrible to be described in words. Surely we should hearken to advice such as was given by Lord Rosebery at Chatham recently, but not even wait until the war is over 'to put our Empire on a business footing'; rather should we at once set to work 'to consider deliberately, patiently, and scientifically the methods by which we have been accustomed to proceed, and see in what way they have fallen short, and determine to reconsider and revise them."—I am, &c.,

"HENRY E. ARMSTRONG.

"Central Technical College,
"South Kensington, April 2."

THE SIMPLON TUNNEL.

On November 13th, 1898, work was begun on the Simplon Tunnel. According to the United States Consul at Berne the contract provides for its completion in five and a half years, and the price to be paid is 69,500,000 francs (£2,780,000). It will have a length of 20 kilometres (12 miles), and will be the longest tunnel in the world. When completed it will be the third one connecting Italy with outlying countries by direct rail, and will effect a saving of 77 kilometres (43 miles), or from 7 to 8 per cent. on the journey from Paris to Milan, as compared with the Mont Cenis or St. Gothard tunnels. The Mont Cenis tunnel has a length of 13 kilometres (8 miles), and the St. Gothard a length of 15 kilometres (9 miles). When in the fifties the wonderful project of drilling the Mont Cenis tunnel was undertaken, fathered by the Italian Minister of State, Signor Cavour, no machines for drilling were in existence, and it was estimated that a period of 20 years would be necessitated for every 5 kilometres (3·1 miles) of tunnel drilled. Then M. Sommeillier, who was engineer in charge of the work, constructed the first drilling machine, and although crude, it was satisfactory enough to accomplish ten times the work done by manual labour and enabled him to finish the tunnel in 11 years. The St. Gothard tunnel was finished in from 8 to 10 years. The Simplon t begins in Switzerland near the little town of Bri the valley of the Rhone, and ends in the valley c Diveria, on the Italian side, near Isella. It w perfectly straight except for a small curve a ingress and egress. The fundamental princip tunnelling always has been to drive the hole, exc and follow it up with the finishing masonry, m provision, of course, for ventilation, which is gen sufficient at first, but which becomes insufficient the work progresses towards the centre, whe incoming fresh air mixes with the outgoing The method employed by the engineer who has in charge of the undertaking is to drive two parallel within the radius of the excavations, le a dividing line, one hole being excavated abo feet in advance of the other. These are built single line, and later on the dividing wall ca broken through for double lines if necessary. distances of about 656 feet transverse conne between the tunnels are made through the di wall and are provided with doors. To o sufficient ventilation powerful air blasts are l into one side of the tunnel, which return throug other side of the division and thereby conduct ward all foul air and bad gases. When the air i interior increases in heat it is cooled by showe cold water which has been led from the exterior c mountains under high pressure. Through pra experiments in the mines of Spain the engine charge has proved that air at 121° Fahrenheit by means can be reduced to 59° Fahrenheit. These streams furnish 1,000 horse-power for driving The miners, therefore, always work in an art atmosphere of cool fresh air. The invention o engineer in charge is a hydraulic rotary dr machine, by which it is hoped to complete the t in less than contract time. It is used singly a battery form. Prominent engineers, accordin Consul Frankenthal, come from far and nea examine this powerful mechanism. Another o engineer's inventions is a machine for loosening removing the *débris* after the explosions and b It throws a powerful stream of water into the s loosened by the force of the blasting, thereby wa away the dirt. This makes excavation easier. T machines run on rails, and when in use follow other in rotation. The historical museum o Kaiserlich and Königlich State Railways in V possesses the first hydraulic rotary machine inv by the engineer in charge, which he used in tunn through the Arlberg, in Austria, in 1867.

ALUMINIUM AND PARTINIUM.

Thanks to progress in manufacture, aluminiu now produced pure to within 93 to 99 per c observed by M. Henri Moissan to the Fr

emy of Science, while the most disadvan-us impurities, sodium, carbon, iron, and silicon, liminated. An alloy containing 96 per cent. of nium would appear to be that most employed; his metal, in the form of bars, angles, tees, and s, lends itself to all forms of construction that re extreme lightness combined with great ance.

nong the many current applications of aluminium be mentioned the following:—In telegraphy and hony, wires and cables; for military purposes, and mountain gun-carriages, armour plates, dge-cases, sword-scabbards, helmets, cuirasses, tirrups; in cycles, all detached parts; for light-coal-gas and acetylene tubes; in music, wind uments; and for surgery, all instruments; as as kitchen utensils, watch-cases, and the metal of telescopes and field-glasses. As regards new cations, this metal is largely used in the pros-us motor-car industry, a large proportion of inium, and especially its alloys, being used, not in the accessory parts of the frames, but also for rincipal parts of the body; and, up to a certain , it is possible to give the alloy the qualities of gth, cohesion, &c., required for each case.

rtinium, so named after its inventor, Henry n, is a mixture of aluminium (having the density 56) with tungsten (having the density of 18), h alloy combines with the lightness of aluminium istance increasing with the tungsten content. in sand, the density of this alloy is 2·89; its ance to tensile strain is 12 to 17 kilogrammes square millimetre (mean 9 tons per square inch), its elongation from 12 to 6 per cent., according e proportion of the two metals. When rolled, lensity of partinium is 3·09; its resistance to le strain from 32 to 37 kilogrammes per square netre (mean 22 tons per square inch), and its gation from 8 to 6 per cent.

all the above-named applications, for brass gun-metal there is substituted an alloy which has half their weight with one-third greater re-nce; and the cost of a part merely cast is reater whether it be of gun-metal or partinium, that of a finished part is even less when made ie latter metal. Rolled partinium is now used he bodies of motor-cars, lending itself to any ired form; and a body made of this alloy, nted on a frame built of angle-bars, with roof heet partinium, constitutes a metallic whole h, for equal strength, weighs from 50 to 60 cent. less than one made of wood, while with in precautions it can receive the same paint-is the best-finished carriage. The first partinium body dates from 1898; and this use of the has since become general. Now that crush-strain tests have shown that this metal can d a compression strain of 38·2 kilogrammes square millimetre (24 tons per square inch) out deformation, it has been largely used for ing portable houses.

Since the first production of aluminium by Sainte Claire Deville, the price of aluminium has decreased enormously, as will be seen by the following figures:—

Year.	Per Kilogramme. Francs.	Per lb. £	s.	d.
1854	3,000	54	10	10
1856	1,500	27	5	5
1859	400	7	17	8
1864	100	1	11	9
1889	80	1	9	1
1891	20	0	7	3
1892	12	0	4	5
1894	5	0	1	8
1896	4	0	1	5½
1899	3·5	0	1	3½

These particulars are communicated to the "Revue Automible" of the *Chronique Industrielle* by M. Auscher, Ingénieur des Arts et Manufactures, who concludes with the observation that, if too much was said at first about aluminium being the metal of the future, it cannot be denied the claim of being "a metal with a future," the appreciation in which it may be held depending in each case on the judgment with which the application is made, and the proportion of the component parts in its alloys.

THE GREAT CENTRAL RAILWAY.

Two papers were read on "The Great Central Railway Extension," at a late meeting of the Institution of Civil Engineers.

The first, by Mr. F. W. Bidder, M.Inst.C.E., on the "Northern Division," referred to the line from Annesley to Rugby. After giving a concise history of the events which led to the extension of the Manchester, Sheffield, and Lincolnshire Railway southwards, the author stated that the Northern Division commenced by a junction with the Derbyshire lines of the company near Annesley, and ran in a southerly direction through Nottingham, Loughborough, and Leicester to the Oxford Canal, near Rugby, the total distance being 51 miles 69 chains. There were 16 passenger stations upon this division, the most important being the Central Station at Nottingham, the joint property of the Great Central and Great Northern Railway Companies, and the stations at Leicester and Loughborough. Large goods yards had been laid out at Nottingham, Loughborough, and Leicester, and extensive gravitation-sorting sidings have been provided at Annesley. For the locomotive and carriage and wagon departments accommodation had been provided at Annesley, New Basford, Nottingham, and Leicester. The gradients were good, the steepest being 1 in 130 north of Nottingham, and with the exception of two short lengths, 1 in 176 south of Nottingham. The line had been laid out with very easy curves. the

minimum radius being 80 chains, except in approaching the stations at Nottingham and Leicester. Between Annesley and Nottingham the cuttings were in the Magnesium Limestone and Bunter Sandstone; south of Nottingham they are for some distance in the Keuper Marl, Rhætic Shale being met with near East Leake. Beyond this point many of the cuttings were in the boulder clay, and south of Leicester they were chiefly in the red marl, boulder clay, and the blue clays of the Lower Lias. The total quantity of excavation amounted to over 6,000,000 cubic yards, but no great difficulty was experienced in dealing with the earthworks, every precaution being taken to secure good drainage where necessary. There were in all five tunnels, with a total length of 1,430 yards, and eleven viaducts, covering altogether a distance of about 3,400 yards. The bridges were very numerous and varied in character, no less than 224 being required, and of these 155 had steel superstructures. Wherever practicable, brick arches had been adopted in preference to girder spans, both for underbridges and overbridges. The brickwork throughout was built in Old English bond, of common brick faced with Staffordshire brindles. The coping to bridges and viaducts consisted of specially moulded Staffordshire blue bricks. Girder beds, arch springers, newel and pilaster caps, &c., were of Derbyshire grit stone. Mild steel was used throughout for all girder work in bridges, buildings, and platform roofing, cast-iron being used only for girder bearings, base mouldings, corbels, small roof-columns, &c. The total quantity of iron and steel used upon the Northern Division amounted to over 20,000 tons.

The second paper, by Mr. Douglas Fox, M.A., Assoc. M.Inst.C.E., on the "Southern Division," described the line from Rugby to the London terminus.

The length of the Southern Division, including the Banbury branch and junctions, was $50\frac{2}{3}$ miles. It started at a point a short distance north of the London and North-Western Railway Station at Rugby, and 121 miles 44 chains south of Manchester. The railway ran in a southerly direction through the counties of Warwick, Northampton, Buckingham, and Oxford, to a junction at Quainton Road with the Aylesbury and Buckingham branch of the Metropolitan Railway in the parish of Quainton, a distance of about 40 miles of double main line.

The main line between Rugby and Quainton Road passed through a rich grazing country, not very thickly populated, which was generally of a smooth, undulating character, with ridges running east and west, of lias and Oxford clays, and beds of a softish white limestone. As the direction of the railway was almost due north and south, this entailed heavy earthworks in cutting through the ridges and embanking the valleys. Cuttings and embankments of over 50 feet in depth and height respectively were of frequent occurrence, and in one case, at Catesby, where the ridge was of unusual height, a tunnel of 3,000 yards in length was considered necessary. The
difficulty of crossing such a country economicall
increased by the fact that the maximum gr
allowed on this division was 1 in 176, or 30 fee
mile, and the minimum curve 60 chains radiu
that in one case only, the normal curve being
radius. These severe restrictions were neces
by the company's resolve to secure a firs
running line, as direct as possible, and with
curves and flat gradients, so as to accommodat
speeds. The highest point above the sea reach
the railway on this division was 503 feet, at
welton Station, and between that station
Brackley it followed more or less the line
watershed, crossing the Cherwell river, which
west and joined the Thames at Oxford, and the
fordshire Ouse, which flowed east into the Was

The paper described very minutely the very
plete system of cutting and intercepting
adopted, and the methods of preventing slip
soft clay cuttings the ballasting consisted of
"blanket" of 2 inches of burnt clay ballast, or
gravel, to dry up the foundation and to keep t
9 inches of large stone or slag bottom ballast
sinking in, (3) over the bottom ballast a "blen
of 2 inches of coarse gravel, preparing the surfac
filling up the larger interstices of the bottom b
for the (4) top ballast, some 9 inches deep, of
broken ironstone slag from works in the neigh
hood of Northampton. On high embankments
to settlement the bottom ballast of large ston
done away with, from 12 to 24 inches (accordi
settlement) of hard clinker-burnt clay ballast
substituted in its place; this was made up a
embankments settled, and at the very last the n
top ballast of broken slag was laid.

The permanent way used consisted of double-h
steel rails, supported in 51 lb. cast-iron chairs, s
to creosoted sleepers, 9 feet long by 10 inches
and 5 inches deep. Steel fish-plates weighing
were used.

The only three stations of importance on this
sion were those at Rugby, Woodford, and Bra
the other six being of the ordinary country type

For the bridges, both over and under, bric
was used wherever practicable, to save the a
cost of maintenance. Where metal was obliga
feature in the design of the steelwork was th
nearly every case both up and down roads h
complete span and structure to themselves, so th
case of any damage to either half of the bridg
other half was available and independent to re
the diverted traffic; and one half could be rep
without interference with its neighbour. S
different types of bridges were adopted.

All the steelwork was erected without interfe
with the London and North-Western Railway
pany's traffic.

A full description was also given of the Ca
Tunnel, 3,000 lineal yards long, the only tunnel o
southern division, with a description of the geol
strata passed through.

EPOCHS IN DYEING.

h the steady progress and the many develop- which have taken place in the coal-tar colour ry, there have naturally been introduced changes t branch of industry which concerns itself with pplication of colour to textile fabrics—namely, reat dyeing industry. It is interesting to note hanges which have taken place in the methods eing since the introduction of Perkin's mauve Iofmann's magenta. Before then it was largely em of rule of thumb, and while there is still of this old system left, the modern dyer works nore scientific basis. Part of this change is no due to the fact that the dyer now works with ounds of the composition of which definite know- exists. This was certainly not the case with d-fashioned colouring matters of natural origin. 1856 appeared Perkin's mauve, the introduction hich unquestionably marked an epoch in the y of dyeing, for with its appearance began these ges in methods which have made dyeing a simpler than it used to be. Following close on this the introduction of magenta, first placed on the ish market by Messrs. Brooke, Simpson and er, although a dyer at Coventry named Hands ook up its manufacture. The next epoch in the ry of dyeing was marked when Perkin in this try, and Graebe and Lieberman on the Continent, made alizarin, which has brought about many ges in turkey-red dyeing, wool dyeing, and calico- ing. Then a few years later came the introduc- by Witt and Griess, of the azo oranges and ets, which have caused quite a revolution in the ods of dyeing wool and silk; for the method of cation is very simple, and yet what a variety of and shades can be obtained from them! Finally, ntroduction of Congo red (in 1885) again marked ry important epoch in the history of dyeing, ially in the cotton branch, for following it there come in rapid succession a class of dyestuffs ng the property of dyeing unmordanted cotton, a erty shared by no other class of coal-tar colours, only by safflower, annatto, and turmeric among al dyestuffs, and by these but to a limited extent, iere near approaching the powers of the new of coal-tar colours.

few years before this Messrs. Read Holliday Sons developed a process for the production soluble azo colours directly on the fibre. Un- nately dyers have not devoted as much attention is method of dyeing as its merits deserve. How- there is a probability that in the future it will be reat service to dyers, owing to the great pro- nce which it has been given by the introduction rimuline in 1888 by Messrs. Brooke, Simpson, Spiller. This latter dyestuff was not only able ye cotton directly without a mordant, but by first ing through a diazotising bath of sodium nitrite, then into a bath of some developer, new and fast colours were developed on the fibre, the particular colour depending upon the kind of developer used. Thus, with beta-naphthol, a bright red was obtained; with alpha-naphthol, a maroon was the result; with resorcin, an orange; with phenol, a deep yellow; and with naphthylamine ether, a blue. Unfortunately these colours are not perfectly fast, although they are dyed on a large scale in many works, and for certain classes of fabrics they possess many advantages over some of the direct reds. More recently a new class has been introduced which has the property of combining direct with diazotised aniline or paranitraniline, forming new and very fast shades.

The introduction (in 1898) of the Vidal black, which has since been followed by other blacks of the same kind, has placed cotton dyers in a position to produce very simply very fast blacks. The introduction of the coal-tar colours has given an impetus to the printing of woollen and silk fabrics. Although these operations were carried out before on a limited scale, yet the wool and silk printer found himself beset with difficulties when he used the old-fashioned natural dyestuffs. The application of the coal-tar colours to this particular branch of textile colouring presents very few difficulties, and these are readily overcome; hence it is not wonderful to find that silk and wool printing are now coming to the front.—*The Textile Mercury.*

THE IRON AND STEEL INDUSTRIES OF GERMANY.

According to a recent German trade review, the official returns of the iron and steel industries of Germany for 1898 have just been issned. It appears from these returns that the output of iron ores has advanced from 11,457,000 tons in 1893, to 15,900,000 in 1898, the average vatue per ton having for the same period increased from 3s. 6d. to about 3s. 9d. The number of mines at work has, however, diminished from 561 in 1893, to 550 in 1898. That there has been a material increase in efficiency of the individual worker, as well as in the output of the individual mine, is proved by the fact that the number of workers between 1893 and 1898 had only increased from 34,845 to 38,320. In addition to the ores produced at home in 1898, Germany made use of 2,718,000 tons of imported ores, her total consumption in that year having been 18,183,000 tons, or an average, including imported ores of about $2\frac{1}{2}$ tons of ore per ton of pig. The German production of pig-iron in 1898 was 7,313,766 tons, against 6,881,466 tons in the previous year, and 4,986,000 tons in 1893. The number of workmen employed at German blast furnaces had increased from 24,201 in 1893, to 30,778 in 1898, but the average output of pig-iron per workman had increased from 206 tons to 240 tons. Within the same interval the average output of pig-iron per furnace in blast increased from

24,400 to 28,700 tons. As regards manufactured iron, there were still, 1898, 176 works in Germany engaged in the production, of which the total output was 1,077,363 tons, against 1,031,691 tons in 1897, and 1,078,065 tons in 1893. The number of workmen engaged in malleable iron works in 1898 was 38,135, which compares well with 39,958 in the previous year, and with 40,342 in 1893. The German output of finished steel has increased from 2,231,873 tons in 1893, to 4,352,831 tons in 1898, while, at the same time, the output of ingots, billets, &c., for sale has increased from 931,569 tons to 1,428,173 tons. Hence, in 1898, there was an increase of 2,618,000 tons, or 82 per cent., in the total German steel production, which is by far the largest advance made in any similar period. The number of works in the German steel industry has during the same six years increased from 139 to 170, and the number of workmen employed in them from 65,944 to 10,650.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday evenings at 8 o'clock :—

May 2.—"Some Unfamiliar Masterpieces of the Italian School." By Miss Halsey.

May 9.—"Improvement of our Roads." By A. Moresby White. Sir John Wolfe Barry, K.C.B., Chairman of the Council, will preside.

May 16.—"A National Repository for Science and Art." By Prof. Flinders Petrie.

Indian Section.

Thursday afternoons at 4.30 o'clock :—

May 17.—The Industrial Development of India." By Jervoise Athelstane Baines, C.S.I.

Foreign and Colonial Section.

Tuesday afternoons at 4.30 o'clock :—

Date to be hereafter announced :—"Imperial Telegraphic Communication." By Sir Edward Sassoon, Bart., M.P.

Applied Art Section.

Tuesday evenings at 8 o'clock :—

May 8.—"Art Metal Work." By Nelson Dawson. Henry H. Cunynghame, C.B., will preside.

Cantor Lectures.

Monday evenings at 8 o'clock :—

Prof. Vivian B. Lewes, "The Incandescent Gas Mantle and its Use." Three Lectures.

Lecture I.—May 7.

The History of Incandescent Gas Lighting.—The discoveries that led to the mantles of to-day—The oxides suitable for mantle-making and their preparation—The services of thoria and ceria, and the methods adopted for their extraction,

MEETINGS FOR THE ENSUING WEE

Monday, April 30...Geographical, University of Lon Burlington-gardens, W., 8½ p.m.

Actuaries, Staples-inn Hall, Holborn, 5½ p.m.

Tuesday, May 1...Royal Institution, Albemarle-street 3 p.m. Dr. H. R. Mill, "Studies in Bi Geography." (Lecture II.), 5 p.m. Ar Meeting.

Pathological, 20, Hanover-square, W., 8½ p.m.

Biblical Archæology, 37, Great Russell-street, W 8 p.m.

Wednesday, May 2...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. Miss Halsey, "S Unfamiliar Masters of the Italian School."

Archæological Association, 32, Sackville-street 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Institution, Oxford-mansion, Oxf street, W., 4 p.m.

Thursday, May 3...Antiquaries, Burlington-house, W., 8½

Linnean, Burlington-house, W., 8 p.m. 1. R. J. Anderson, "Note on the Movement Fishes." 2. Miss E. S. Barton, "New Speci *Halimeda*, from Funafuti." 3. Miss A. L. Sı "West Indian Fungi."

Chemical, Burlington-house, W., 8 p.m. 1. Me A. W. Gilbody, W. H. Perkin, jun., and J. Y "Brazilin." (Part IV.) 2. Messrs. W. H, Pe jun., and J. Yates, "Haematoxylin." (Par 3. Messrs. F. D. Chattaway and K. J. P. O "The substituted nitrogen chlorides and bron derived from *o*- and *p*-acet-toluide, and their tion to the substitution of halogens in toluides toluidines."

Society for the Encouragement of Fine Art Conduit-street, W., 8 p.m. Mr. R. Cam "The Growth of Art in our Public Schools."

Royal Institution, Albemarle - street, W., 3 Prof. Dewar, "A Century of Chemistry in Royal Institution." (Lecture II.)

Electrical Engineers, in the Rooms of the Institi of Mechanical Engineers, Storey's-gate, S 8 p.m. 1. Discussion on Professor Forbes' p "Transmission of Electric Power." 2. H Sayers, "The Calculations of Distribution Sys of Electric Traction under British Conditions.

Hellenic Society, 22, Albemarle-street, W., 5 p.

Friday, May 4...United Service Institution, White yard, S.W., 3 p.m. Lecture by Major Yates.

Royal Institution, Albemarle-street. W., 8 Weekly Meeting, 9 p.m. Prof. T. E. Th "Pottery and Plumbism."

Cold Storage and Ice Association, in the Exan tion-hall of the Royal Colleges of Physicians Surgeons, Victoria-embankment, W.C. 11.30 1. Mr. G. Halliday, "Recent Researches in frigeration." 2. Mr. W. D. A. Bost, "Insul and Insulators." 3. p.m. 1. Mr. W. B. E "Electric Lighting of Cold Stores." 2. Mr Gaskell, "The Design and Construction of B ings for Ice Factories and Cold Storage."

Geologists' Association, University College, W 8 p.m.

Junior Engineers, Westminster Palace - h S.W., 8 p.m. Messrs. C. H. Rush and B. C. "A Short Review of the Motor-car Industry : and Present."

Philological, University College, W.C., 8 Annual Meeting.

Quekett Microscopical Club, 20, Hanover-sq W.C., 8 p.m.

Saturday, May 5.. Royal Institution, Albemarle-street 3 p.m. Professor Stanley Lane-Poole, "E in the Middle Ages." (Lecture II.)

Journal of the Society of Arts,

No. 2,476. Vol. XLVIII.

FRIDAY, MAY 4, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

The Society's *Conversazione* will take place the Natural History Museum, Cromwell-ad, S.W. (by permission of the Trustees of e British Museum), on Wednesday Evening, e 20th June, from 9 to 12 p.m.

The following portions of the Museum will open:—On the Ground Floor—the Central all, British Saloon, and the Fossil and Mam-alia and Reptilia Galleries; on the First oor—the East and West Corridors.

Each member is entitled to a card for him-lf (which will not be transferable), and a rd for a lady. In addition to this, a limited mber of tickets will be sold to members of e Society, or to persons introduced by a ember, at the price of 5s. each, if purchased fore the date of the *Conversazione*. On at day the price will be raised to 7s. 6d.

These tickets will only be supplied to per-ns presenting members' vouchers (which n be obtained from the Secretary) or a letter introduction from a member.

Members can purchase these additional kets by personal application, or by letter dressed to the Secretary. In all cases of plication by letter a remittance must be closed. Each ticket will admit one person, her lady or gentleman.

Light refreshments (tea, coffee, ices, claret p, &c.) will be supplied.

PRACTICAL EXAMINATIONS IN MUSIC.

The Practical Examinations in Vocal and strumental Music will be conducted by Mr. hn Farmer, Balliol College, Oxford, and rector of the Harrow Music School, Examiner, and Mr. Ernest Walker, M.A., Mus.Doc., Oxon, and Mr. Burnham Horner, Assistant Examiners, at the House of the Society, and will commence on Monday, 25th June.

The last day for receiving applications is Friday, 11th May.

Particulars can be obtained on application to the Secretary.

Proceedings of the Society.

NINETEENTH ORDINARY MEETING.

Wednesday, May 2, 1900; Lewis Foreman Day, Member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Brown, John McLeavy, C.M.G., Seoul, Korea.
Campbell, P. P., Anuradhapura, Ceylon.
Charlier, Andrew C. J., Sussex-house, Hill-street, Glasgow.
Cooper, Henry, Messrs. Vickers, Sons, and Maxim, Limited, Sheffield.
Dawkins, Clinton Edward, Brooks's Club, St. James's-street, S.W.
Dissanaike, Edwin Seneviratne, Technical College, Colombo, Ceylon.
Gestetner, D., Norselands, 124, Highbury New-park, N.
Gorbold, Henry, 20, Goldsmith's-row, Hackney-road, E.
Griffiths, John, Binton-cottage, near Farnham, Surrey.
Grosvenor, George William, Broome-house, Stourbridge, and Worcester-cross, Kidderminster.
Hare, Lancelot, Bankipore, E.I. Railway, India.
Harris, Jonathan James, Grey Abbey, Cockermouth.
Hughes of Kinmel, Hugh Robert, Kinmel-park, Abergele.
Ker, Robert Wilson, 72, Upper Parliament-street, Liverpool.
Kindersley, M. F., Cavalry Club, Piccadilly, W.
Leslie, William, 2, Chowringhee-road, Calcutta, India.
Madhowlal, Chinoobhai, Ahmedabad, near Bombay, India.
Michell, Brigadier-General St. John Fancourt, Bareilly, India.
Muir-Mackenzie, the Hon. John William Pitt, Royal Bombay Yacht Club, Bombay, India.
Perrins, Charles William Dyson, J.P., Davenham, Malvern.
Phillott, George Henry, M.A., 13, Promenade, Cheltenham.

Pigott, John Robert Wilson, Paramaribo, Surinam, and Highfield, Bath-road, Reading.
Reitmeyer, Robert, Shortlands, Kent.
Rutnagur, Sorabji Muncherji, 27, Meadow-street, Bombay, India.
Slater, John Sanders, B.A., B.L., Malabar-hill, Bombay, India.
Wacha, Dinshaw Edulji, 84, Hornby-road, Bombay, India.
Weil, Walter Horace, Stock Exchange, E.C.
Woollen, Thomas Henry, Arrol Works, Long Acre, Aston, Birmingham.

The following candidates were balloted for and duly elected members of the Society:—

Gilman, Edward Philip Reuben, Burdwar, Palasbari, P.O., Assam, India.
Gordon-Parker, Dr. J., Herold's Institute, Drummond-road, Bermondsey, S.E.
Jackson, Sir Thomas, Hong-Kong, China.
King, D., Bank of Calcutta, Limited, Calcutta, India.
McMechan, Samuel J., Beech-hill, Kersal, Manchester.
Mistri, N. R., 4, Bruce-lane, Fort, Bombay, India.
Reid, David, Shootfield, Sundridge, Sevenoaks, Kent.
Shorland, E. H., Drake-street Works, Stretford-road, Manchester.
Spence, Horace Robert, 3, Lexham-road, Colchester.
Turri, George G., Salisbury-building, Queen and Bourke-streets, Melbourne, Australia.
Vecqueray, Arthur Hermann, British Consulate, Cadiz, Spain.
Waters, Lieut.-Col. George, I.M.S., Bombay, India.
Zilz, Henry, 22, Bush-lane, Cannon-street, E.C.

The paper read was—

SOME UNFAMILIAR MASTERPIECES OF ITALIAN ART.

By Miss Ethel Halsey.

In calling my paper "Some Unfamiliar Masterpieces of Italian Art," I need hardly say that the pictures which I shall have the pleasure of showing you this evening are not unknown to students and experts, and those of us who have had leisure to explore the more remote parts of Italy; but I think I may safely say that they are *unfamiliar* to the large majority of travellers in that country. The great artistic centres of Milan, Venice, Bologna, Florence, Perugia, Siena and Rome are well known, and I have therefore not included any work of art from those towns in my list to-night, with the exception of two or three in private houses, which have been photographed recently. I have made a sort of pot-pourri of pictures to be seen in small towns and villages, and by the help of a map I will point out at the end of the paper where th are to be found and how to get there, in ca any of you feel tempted to go and see th originals for yourselves. I may add that th scenery alone often more than repays the tim and trouble taken, and in these out-of-the-wa districts one gains a varied and intima acquaintance with one of the most picturesq countries in the world.

In showing a succession of slides repr senting works belonging to different school different centuries, and different provinces, has been a little difficult to keep to a chron logical order. As far as possible I have dor so, but it has not always been feasible. I hav also had to leave out the work of several artis because it would have made my paper too lon and complicated to have included more. I hav introduced some because they are not repr sented, or *inadequately* represented in ou National Gallery, and it is only when one visit their native town or province that we ca realise how great these artists really were.

In this slight sketch I have not attempted t go into the minute details that modern scientifi research demands. It would take far too long though I do think a knowledge of that syster is the most satisfactory way of getting th essential qualities and distinctions of th various schools clearly and definitely fixed i one's mind.

I shall ask you to accompany me in a littl "giro" through Italy, taking the pictures o the various schools in the following order:—

First, some of the Florentine school; secondly some of the Umbrian school; then, crossin the Apennines into the Marches we shall fin works by the Venetians along the Adriati coast; and, finally, leaving Venetia, we wi end with some works by the Lombard artists.

The first slides represent a series of frescoe by the Florentine artist Masolino.

Tommaso Cristofero, called Masolino d Panicale, is best known to us as the reputed master of the brilliant Masaccio, but we know that he was held in great esteem by his con temporaries. He was born at Panicale in 1383, and was pupil of Lorenzo Ghiberti. We read that in 1427 he made arrangements to g to Hungary in the service of a certain Filipp Scolari, a Hungarian, who was then a Florence, and who was probably an admire of Masolino's work in the Carmine, which had been recently done. I may here mention tha little, if any, of Masolino's work exists now in the Brancacci Chapel. His work on th ceiling has completely disappeared. The res

f the frescoes are nearly all by Masaccio with he exception of one or two fragments, which ,ere finished later by Filippino Lippi. For hose who care to study further the work of Iasolino and Masaccio and their relations o each other, I would recommend August chmarsow's monographs on these two artists, vhich are illustrated by two large portfolios of eautiful photographs, and can be seen in the Art Library at South Kensington.

Masolino seems to have gone to Hungary *vià* Lombardy, for we find some frescoes dated 428 at Castiglione, Olona, a small village hirty miles north of Milan. It belonged to he Castiglione family, and it was a certain Cardinal Branda Castiglione who commisioned Masolino to paint frescoes in the hurch of his native place. These, which epresent scenes from the lives of the Virgin, St. Stephen and St. Lawrence, have been nuch injured by damp, though there are some lelightful bits here and there. On his return rom Hungary some years later he painted a eries of frescoes in the Baptistry, which, like nany of the baptistries in Italy, is a separate building from the church. They represent cenes from *the life of John the Baptist*, and vere finished in 1435, and are for the most part in a wonderful state of preservation. The xquisitely delicate colouring is the most deightful part of these frescoes, and those who have only seen his frescoes at San Clemente in Rome, blackened by time and ruined by damp, can have but a limited appreciation of his art. To see him at his best we must go to Castiglione, Olona, where the clear and beautiful colouring combined with an earnest attempt at nodelling and perspective, show him to be a not unworthy contemporary of Fra Angelico, Paolo Uccello, and Donatello.

This, as we see, represents John preaching at Bethabara, beyond Jordan. Two of the rescoes represent this subject, but judging by the presence of Christ and two disciples n the crowd, the moment chosen here is bviously when John said, "There standeth one among you whom ye know not." The wo figures in the foreground are distinctly portraits, probably of members of the Castiglione family. This fresco is the most injured as it is on the north or weather-wall.

Baptism of Christ.—This is one of the best preserved of the series, and also one of he most interesting, for it shows so clearly he mingling of the old and new forms of artistic expression of that day. There is the usual conventional composition of Christ, and the Baptist, and the Angels, but in the animated group in the background Masolino grapples with the difficulties of anatomy and movement very successfully in each of the figures.

John Reproving Herod.—Morelli says of Masolino that he was the first to introduce dramatic character into painting. We see this very clearly in the rage depicted on Herod's face, and on that of the guard seizing John.

Herod's Feast.—In the composition of this fresco the architectural background gives scope for that love of perspective and elaborate decoration which the Renaissance artists delighted in. I would call your attention to the dainty loggia, with the charming frieze of "putti." I cannot help thinking that this particular frieze really existed either in Rome or Florence. In 1450, Jean Fouquet passed down Italy to Rome, where he went to paint the portrait of Pope Nicholas V. On his return to France he illuminated the famous "Book of Hours" for Jean Etienne. Forty pages of this book are at Chantilly, and we find this particular loggia and frieze reproduced three or four times, almost line for line. Masolino's fresco, viewed in light of this fact, points to the existence of some classic sculpture of this design, which both artists had known and sketched.

This is one of the details of the foregoing fresco enlarged, and represents Salome asking for John's head on a charger. The heads of Salome and of the youth in the crowd are types of youthful beauty, and there is a delicate feeling for line in the long sweep of Salome's dress.

The other half of this scene, representing Herod at table, gives ample scope for dramatic expression. Herod seems almost stunned as he realises what his oath involves, while the prelate next him, possibly the portrait of Cardinal Branda himself, raises his hands in horror. The old man next him is looking with pained astonishment at the fair young girl making this blood-thirsty demand, while the young man looks quickly up the table curious to know what Herod will do.

Salome presenting John's head to Herodias.—In the beautiful form of Herodias we have one of the most graceful and dignified figures in Masolino's work. It is only by comparison that we can realise how great an advance in art Masolino's work is to that of the majority of his contemporaries. When we remember the work in the Spanish Chapel at Florence, we realise what a triumph of strong

and beautiful line this is, and there is no doubt that he exercised an immense influence on the next generation of artists at Florence.

The only other picture of the Florentine school on my list is one that is in a private collection at Rome. It is called the "Derelitta; or, the Deserted," and is attributed to Botticelli, and is certainly of his school. It is interesting to speculate about the artist, for it is so thoroughly imbued with the sentiment and intensity of Botticelli that it must have been painted by one of his followers, and one who was closely in touch with him. The architectural background plays so prominent a part in the composition that it probably was done by an artist who was an architect as well as a painter. It has been pointed out by a distinguished art critic, that the only artist in the Botticelli group, who was great both as a painter and as an architect, was Giuliano di San Gallo, whose work he believes it to be, and he bases his statement on the similarity existing between this picture and the architectural sketches by Giuliano, which are in the Barberini Library at Rome. When we remember the beautiful tondo by Giuliano in our National Gallery we see he is quite capable of the wonderful feeling in this picture. The supreme pathos of the grief-bowed figure, the impassable bronze door, the stern stone walls, the dramatic lines of the drapery thrown here and there in despair, give an atmosphere of desolation to the scene. I only know one other artist who at all approaches this feeling, and I think this picture would make a good pendant to "Love among the Ruins," when Love is gone and the human Soul is left to its solitary fate. There is a fine passage in Zola's "Rome" about this picture, describing it and speculating about it and ending with these words: "elle ne fut là sentement le symbole de tout ce qui frissonne et pleure, sans visage, devout la porte éternellement close de l'invisible."

This picture belongs to Prince Piccolomini, and is in his palace at Rome.

We will now pass on to an artist who is generally called an Umbrian, but without much justification as far as his *art* is concerned—I mean Piero dei Franceschi. It is quite true that some years of his life were passed at Borgo san Sepolcro, but he studied as a youth at Florence, and his art has a close affinity to that of the Florentines, and especially to that scientific school of which Paolo Uccello and Andrea del Castagno were the pioneers. His colouring was influenced by Domenico Veneziano and also by Masolino. His style is simple, direct and great, and I prefer simply to call him an artist of central Italy, as he is one of those roving lights who cannot be pinned down to any special school.

This fresco is dated 1521, and is, therefore a very early work. It represents Sigismond Malatesta, Lord of Rimini, and is painted over an archway in the Tempio at Rimini. A letter is in existence, written by Sigismond to one of the Medicis, asking to have an artist sent him, to "paint himself kneeling before his patron saint, Sigismond King of Burgundy." As Borgo San Sepolcro belonged at that time to the Malatesta family, it is at least a plausible theory that his own vassal should have been selected, and thus Piero dei Franceschi began his independent career as State painter at his own Court.

This is a fresco of his later period, when his genius had arrived at his full maturity and in the masterful treatment of this noble and statuesque figure we see the result of his scientific training. It represents the Magdalen, and is in the Cathedral at Arezzo. I have included it in my list, because I look upon it as one of the finest and most representative specimens of the art of Piero dei Franceschi.

We will now go on to the little town of Foligno, and see the work of two artists of that town—Mezzastris da Foligno and Niccolo di Liberatore, who is often miscalled Niccolo d'Alunno. We see at once a great difference between these simple graceful figures and the works which we have been studying, but though these Umbrians did not trouble themselves much about the scientific side of art, we find a delicate sense of feeling combined with the charm of refinement which make them very attractive.

We find in Mezzastris' work the survival of an archaic form of art, and he probably owed much to the influence of Benozzo Gozzoli, who was working in the neighbouring town of Montefalco about 1450. Mezzastris was active during the second half of the 15th century. The best existing works I know of his in Umbria, are those at Foligno, and some which are at Assisi, in the chapel of the Civile Nosocomio, an old hospital in that town.

This fresco is over the entrance of the Convent of Santa Anna delle Contesse at Foligno, and protected from rain by the picturesque old wooden roof. It is well preserved, and most delicate in colouring, while the dainty frieze of "putti," painted on a dark-blue ground,

laying with boughs of red and white roses, is articularly charming. These children are ıll of fun and mischief, and we can see that e delighted in painting them. We find a imilar frieze running round the chapel at ıssisi.

It is interesting to remember that it was for his convent that Raphael painted his great Iadonna da Foligno, now in the Vatican.

Nicolo da Foligno is an artist who is more ·idely known. We have a small and very laborate tryptych by him in the National Fallery. It is an interesting work, and must ıave been painted when he was in the Marches, s the backgrounds, with the glimpses of the ea, represent the country near Macerata and Ionte San Guisto fairly successfully.

This picture is in the church of S. Niccolo t Foligno, and I look upon it as one of the rtist's finest productions. I think that he has chieved more in this than in any of his other vorks. The face of the Madonna is most eautiful, and her dark robe stands out effecively against the cherubs, who are painted in arious tones of gold.

This artist painted principally in Umbria. /asari mentions seeing at Assisi a "Pietà," n which were two angels weeping, "their motion," he says, "so naturally expressed hat no artist of that time could have painted hem better." Niccolo certainly expresses motion most effectively. He shows in his vork certain of the characteristics of Crivelli, vho he must have known in the Marches. Ve find the same attempt to depict intense eligious feeling, often at the absolute sacrifice of all beauty.

Before entering the Marches, I wish to show wo architectural panels which are in a private collection in Rome. They are by the famous ırchitect, Fra Carnavale, of Urbino, a Dominican friar, who was active during the niddle of the 15th century. They are not exactly masterpieces of painting, but they are nteresting as representing the sort of ideals he Renaissance architects aimed at, and vhich are far more elaborate than what we saw in Masolino's work. To give a little life o a purely architectural picture, he introduces scenes from the story of the Virgin. This one epresents the birth of the Virgin, and this one he presentation in the Temple. Fra Carnavale was the master of Bramante, and when we recall the latter's work in Milan we realise the esult of his early teaching. What is very ypical of the spirit of the age is the extraordinary mixture of sacred and profane subjects on the façade of what is meant to be a sacred edifice. Above we have the Annunciation, on the side the Visitation, while below are a Faun and a Bacchante dancing.

When we look at the map of Italy, we see a barrier of mountains dividing the East from the West, and this geographical condition explains easily why Umbria was practically cut off from all Venetian influence, while the sea-board of the Marches allowed facilities of intercourse with Venice.

The Marches consist of the five provinces of Ancona, Pesaro, Urbino, Macerata, and Ascoli, and it was in the last two, Macerata and Ascoli, that most of Crivelli's works were originally to be found. The greater part are now in galleries, the National Gallery in London, and the Brera at Milan have the principal ones.

To understand the rare and singular qualities of Crivelli's work, we must take a hasty glance at the school from which he chiefly derived his peculiar characteristics. He was a Venetian, and had probably studied in the Murano School, but he owes far more to the School at Padua. There were, during the first half of the 15th century, two schools which, roughly speaking, influenced the rest of Italy, the Florentine School and the Paduan School. About 1430, the Paduan School took a special turn towards the classic and decorative arts, mainly through the instrumentality of a certain Squarcione. He was not apparently a professional artist himself, but, from the little we know of him, he seems to have travelled through Sicily, Greece, and even to Constantinople, collecting everywhere Greek carvings in marble and stone, beautiful materials and embroideries. These he collected together at Padua, and the artists studied from them, in fact, it might have been called a school of classic and decorative design. Though there was considerable intercourse between the Florentine and Paduan artists, I think the great difference between them at that time, lay in the fact that with the Florentines, the human interest is the all-absorbing one, while, with the Paduans, it forms part, and sometimes almost a subordinate part of a purely decorative scheme.

There is a good illustration of what I mean in a charming triptych by Mantegna, in the Uffizi. The right wing represents the Circumcision; but though the little group of figures in the foreground is painted with Mantegna's habitual skill and distinction, the eye of the spectator is attracted at once by the background. A fine marble column, crowned by

an elaborately-carved capital, supports the arches of the roof, while the walls are covered with beautiful marbles and a mass of ornamentation.

The greatest artists which this school produced (leaving out the Ferrarese School, which I shall not touch on to-night) were the Bellini, Mantegna, and Crivelli. The Bellini, being the most versatile, lived to practically throw off the influence of their early school, but Mantegna and Crivelli remained true Squarcioneschi to the end of their days. Mantegna learnt the wealth of decorative ornament, the statuesque figures and drapery which seem carved in stone, while Crivelli learnt how to render the rich brocades and gold and silver cloths in which he clothes his saints, the festoons of fruits and flowers (gourds, apples, and cucumbers especially), and the elaborate and intricate carvings on the frames of his pictures. Crivelli seems to have worked a great deal at "Anconas," that is to say altar-pieces, divided into several small partitions. We have a very fine one by him in the National Gallery, which was originally painted for the church of the Dominicans at Ascoli. It is divided into 13 compartments, and is in a magnificently-carved frame.

This picture is at Ancona, and is perhaps not improved by being enlarged, as the original is a tiny panel about 8 by 10 inches, and is painted with the minute finish of a miniature. But it is delightfully characteristic both of Crivelli and of his school. The forked pear or maple tree in the background we find in most Paduan pictures of this time, and is typical of Venetia, where these trees are trimmed so as to leave a strong fork to support the vines which are trained from tree to tree as we see them to this day.

But besides being a great master of decorative art, Crivelli's pictures reveal a spirit of intense religious feeling and ecstatic piety. What took him first to the Marches we do not know, but he lived and worked for 25 years in the quiet little country towns which lie between the Potenza and the Tronto. Perhaps being an artist of a very refined and delicate ideal he preferred to live where he could work at his own conceptions of beauty and saintliness, undisturbed by the ever-advancing tide of pagan ideas which the Renaissance brought to the front. There were also from time to time what we should call revivalist movements going on through Italy. The Marches seem to have been for centuries a favourite haunt of saintly men, who have since been either canonised or beatified by the Holy See. Amongst others we find the names of St. Niccolo di Bari, St. Niccolo di Tolentino, St. Filippo Neri (the first church built in his honour is at Maccerata), and St. Bernardino of Siena. The latter preached constantly in the Marches during this century, and Crivelli, who probably had met him first at Padua, was much influenced by him. There was also the Blessed Ferretti whose tomb, with the recumbent form in the simple monk's robe, is to be seen in the Cathedral at Ancona, while a picture of him in ecstasy, by Crivelli, is one of the gems of our National Gallery.

We must remember also that not far from Ancona is one of the most sacred pilgrim-resorts in Italy—namely, the Church of the Santa Casa at Loreto, and from Crivelli's picture of the Annunciation we gather that he had not only been there, but had studied the construction of the building very carefully.

The Santa Casa, as you no doubt remember, is believed to be the house where the Holy Family dwelt at Nazareth, which had been miraculously transported to Loreto. According to the story, it had also been the home of the Virgin Mary, and the scene of the Annunciation. The house is built of small stone slabs (very similar to those of the Portiuncula, near Assisi), and there is a grated window through which the legend says the Archangel gave his message. Crivelli, in his Annunciations, not only places the Archangel outside the building, giving his message through a grated window, but he also makes the wall of the Virgin's house similar to that of the Santa Casa, while he is careful to introduce some brick-work near by, obviously to emphasise the distinction. You will find this in the big Annunciation in the National Gallery. This one is in the Staedal Institute at Frankfort, and I have included it, partly because it illustrates the above-mentioned facts very clearly, but also because it is such a very good example of Crivelli's power of expressing intense emotion. The Archangel has every wing-feather starting with excitement as he delivers his message, while Mary bows down in rapt awe and humility before the heavenly visitant.

Of course, like a true Squarcioneschi, he adds unlimited ornamentation to the house which does not exist on the Santa Casa, but in the main features sticks to the facts as he knew them, and I think we can now understand that there was much to attract an artist of an intensely pious character to this part of Italy.

Titian.—However charming and subtle are e qualities we find in Crivelli's work, when : stand in front of a picture by Titian we alise at once that we are in the presence of a r more vigorous genius. I need hardly say ıything about Titian. We all know his life ıd works. This picture being at Ancona, ıd therefore rather off the main route, is not ı familiar. It was painted shortly after his reat "Assumption of the Virgin" now in the cademia at Venice, and therefore belongs to ıe of his best periods. This picture was ıinted in 1520, and though the colouring is a :tle blackened by smoke it is still wonderfully ch and glowing. To the left St. Francis ands gazing heavenwards, while to the right t. Blaise, with a fine upward sweep of the rm, directs the attention of Luigi Gozzi, the onor. On a bank of clouds above are the Iadonna and child, the child scrambling in a elightfully natural manner on his mother's nee, throws a blessing to the donor. The ontrast between the celestial and terrestial roups is well contrived, while the figures in ıe foreground stand up finely against the ınset sky with a view of the lagoon and 'enice in the distance. Titian was one of the rst artists to paint *successfully* atmospheric ffects, and the whole of the lower part of the icture is bathed in a warm sunset glow. The Iadonna has a particularly sweet face, and esembles a little Titian's Madonna in the 'atican, this picture, however, being far the nest.

This is the Titian at Treviso, and it was ainted rather earlier than the one we have ıst been looking at. It was commissioned by certain Canonico Malchiostro, who can be een kneeling in the background, while his oat of arms is painted on the wall. The type f the Madonna is very familiar to us in 'itian's works.

Before leaving Treviso, we will look at a 'esco in another church by a certain Jacopo ei Barbari. Jacopo dei Barbari is an interestıg artist, who seems to have spent his life :avelling from one country to another. His 'enetian countrymen called him "dei Barari," or "of the barbarians," because he 'ent amongst the Germans, and those who ved north of the Alps were looked upon as arbarians by the cultured Italians. At Nuremerg he was called Jacopo "Walch," for the ;ermans called the Italians "Walchen." But e was as great as an engraver as a painter, nd is perhaps best known as the "Master of he Caduceus," for he took Mercury's Caduceus as his sign, and puts it on his engravings. He was born about 1450, and died about 1516, and his art forms the link between Italian and German art. We find him more than once at Nuremberg, but he did not leave Venice finally till after 1500, for there is an immense woodcut of a bird's-eye view of Venice by him of that date. He then seems to have gravitated to the Netherlands, and entered the service of the Duchess Margaret of Parma, Regent of the Netherlands. Durer admired his work immensely, and speaks in high terms of Jacopo's power of drawing the right proportions of the human figure, and this fine fresco of a herald amply justifies his praise. Later on in Durer's life, we read in his diary how he visited the Netherlands, and saw the treasures belonging to the Duchess Margaret, amongst them one of Jacopo's sketch-books. He had been dead some years, and Durer asked for the sketch-book, but was told by the Duchess that she had already promised it to her then State-painter, Bernhard von Orley. This fine figure is one of a pair which stand on each side of a monumental slab carved by the Lombardi Brothers.

I believe Dr. Wirkoff has started a theory that the sculptors of the slab also painted the heralds. But I know of no other paintings by the Lombardis at all similar to these frescoes, while these figures have much in common with the portraits by Jacopo at Bergamo and Vienna, and all these works show characteristics which are to be found in the engravings by the master of the Caduceus. I think we can see for ourselves that the artist who painted this was undoubtedly a perfect master of *line*, for it is by its splendid lines that it appeals to us.

Christ Bearing His Cross, by Giorgione.—In shewing this slide I am departing from my rule of only showing works of art *in* Italy itself. This picture was in a private palace at Vicenza till a year or two ago, and is now in a private collection in America. It was, unfortunately, not visited much when still in Italy, and is therefore not well known to travellers. But it has a particular interest of its own, as illustrating the influence Giorgione had over his contemporaries. Whatever Giorgione painted, we find his contemporaries copying him at once. His beautiful "Sleeping Venus," now at Dresden, started the fashion, so to speak, of Sleeping Venuses. His "Concert," now in the Louvre, gave vogue to a series of pictures which are very typical of the Venetian School of this time. If this picture we are now studying had

disappeared, it would have been known as a "lost Giorgione," from the many pictures of this subject still in existence. I may add, for those who care to pursue this subject further, that Signor Orcagna, the librarian at Venice, has made a collection of photographs from these various pictures. He has put them in the row by a photograph of this picture, and it is instructive to see the various attempts by these inferior artists to reproduce the charming and brilliant qualities of the great master's work.

Before passing on to the Lombard School, we will look at a picture by the Brescian artist, Romanino. Though Brescia is now much visited, I do not think this beautiful picture is as well known as it ought to be. We have a fine altar-piece by him in the National Gallery; but the strength and colouring of this is far superior. Romanino was born about 1485 and died 1566. He was admitted to the Painters' Guild at Brescia in 1510. This picture is dated two years later, so it is one of his early works. He was contemporary with Moretto, with whom he has much in common, though their colouring differs to a certain extent. He joined him in a contract to paint one of the chapels in the Church of St. John at Brescia. He also worked at Padua, Cremona, Modena, and other small towns.

This picture is in the Church of St. Francis at Brescia. It is rich and harmonious in colour, and painted with a broad and masterly touch, while his saints are not merely conventional saints, but human beings full of intense human feeling.

In coming to the last school on my list I am giving the works of three artists thoroughly good representatives of the real Lombard School —Zenale, Borgognone, and Gaudenzio Ferrari.

Zenale was born in 1436, and died, aged 90, in 1526. He is believed to have been a pupil of Foppa in his early Bergamo period. He seems to have painted generally in association with a certain Buttinone, and they both worked at Milan and in the neighbourhood. We may infer that Zenale was the greater man of the two, for we know that he was held in high esteem by Leonardo, and was also at one time engineer and architect of the Milan Cathedral. In 1492, when Ludovico Sforza married Beatrice d'Este, both Zenale and Buttinone are in the list of artists summoned to Milan to decorate the rooms in the Castello, which were being prepared for the bride, and also to make designs for the pageants and tournaments held in her honour. A modern critic ascribes this panel to him. It is in a private collection at Bergamo.

This is by Ambrosio de Fossano, generally called Borgognone. His principal works are to be found in Milan or the neighbourhood, especially at the Certosa, where he worked from 1488-94. His career can be divided into three periods: I.—Pre-Certosian. II.—Certosian. III.—Post-Certosian.

He possessed the power of representing calm and devotional feeling of a very high order, and there is a purity and charm in his style which makes his work very attractive, in spite of the rather unpleasant grey flesh tints which, however, improved in his later work. We have two or three good works by him in our National Gallery. This picture is at Pavia, and is, as you may see, very much injured, but I included it because it is a beautiful work, and typical both of Borgognone and of the spirit of his day. The colouring of the picture is charming, with the group of monks in their creamy habits contrasted against the dark blue robe of our Lord. I would point out the delicate treatment of the hands, which are quite out of proportion to the figures, but painted with so much refinement. In the background is a view of the Certosa, the façade of which was finished in 1497. As it is still covered with scaffolding this picture was obviously painted before that date. Above the wall, to the right, we see the roofs of three or four of the cells which, you will remember, open into the big cloister. There are 24 of these little houses, each with a tiny garden at the back. You will remember how Fra Angelico painted in each of the cells at San Marco. Borgognone did something similar in painting for each cell a panel representing the Madonna and child, often with a saint or the portrait of a monk introduced, and always in the background we see a bit of the Certosa, and monks walking about. These panels are now, unfortunately, nearly all lost. There is one in the National Gallery, one (or two?) in the Brera, and I believe there are only some four or five accounted for.

This picture is rather striking as showing the absolute liberty Renaissance artists took with facts. To show the Certosa well he places it on a cliff. As we all remember it lies in a flat, well-watered plain, and the one drawback is that we cannot get a good clear view of the mass of building.

We will now turn to the great Lombard painter Gaudenzio Ferrari, with whose works we will end to-night.

;uadenzio Ferrari was born near Vercelli ›ut 1481 and died about 1548. He was, refore, contemporary with Titian and phael, and belongs to the late Renaissance iod.

Ve do not quite know from whom he got his liest teaching, but there were at Vercelli at t time three or four artists attracted there the neighbouring court of Monferrato. ›vanni Francesco Carotto is the best known hem. He had been a pupil of Mantegna's, l it is just possible that Gaudenzio acquired n him his first knowledge of classic architure such as we find in his frescoes at rallo. The first definite notice we have of ı is when he went to Milan. The artists at lan were at that time divided into two tinct schools, the old school as represented Foppa, Civerchio, Borgognone, Zenale and ers, which was rapidly giving way to the v school which rose from the influence of ›nardo da Vinci.

Ve find Gaudenzio Ferrari working under a tain Stefano Scotto, who belonged to the old ool. One writer, I believe it is Morelli, ıks that he must have worked under ımantino, and bases this statement on the ;ible and sculpturesque character of Braman-›'s work, and on a certain head-dress, all of ich characteristics are to be found in the ly work of Gaudenzio Ferrari. This is quite sible, for he went to Milan to learn what he ıld of the great masters there. He was also ch drawn towards Leonardo da Vinci. As ımante, Bramantino, and Leonardo, left an after the fall of Ludovico Sforza in 1499, ıdenzio Ferrari must have gone to Milan ıe time before.

›n studying the early work of Gaudenzio rari, one is brought to the conclusion that vas the *ideals* of the great Florentine, and his technique, which attracted the young st. As we know, Leonardo particularly ›ve to represent the subtle shades of exssion of face and gestures in his figures, l it is for this that Gaudenzio Ferrari is › famous. His genius was far too great l vigorous to allow him to become a mere vish imitator of Leonardo's types, though ıe of the heads in the Varallo frescoes must 'e been done from studies of the same dels. He had an immense admiration for ›nardo, and in these early years we find ı occasionally proudly inscribing himself as udenzio da Vinci, or Gaudenzio da Vinci da rallo, Varallo being the town where he had ıse property, and was his home at that time.

Gaudenzio Ferrari's bold and striking ways of expressing emotion, his extraordinary fertility of invention, prove him to be one of the most original artists who ever lived. His love of difficult and uncommon attitudes often introduces a fantastical element, but his work always shows real elevation of style and feeling. He possesses the dramatic and virile qualities of Tintoretto and Michael Angelo, but in later years his rapidity of execution and exuberant fancy led him astray, his touch coarsens, his colour-scheme becomes crude and fiery, and the movements of his figures too violent and exaggerated.

I should be inclined to divide his artistic career into three periods:—His early period, which includes the frescoes at Varallo, and lasts to about 1520. His second and greatest period, from 1520 till 1536, and includes the frescoes at Vercelli and Saronno. From that date (1536), though he was working ceaselessly at orders which flowed in, his work deteriorates rapidly till his death, about 1548. Curiously enough, these three periods coincide with his three different homes. During his early life his home was at Varallo; during his second period he moved to Vercelli; and finally, when the French invaded Piedmont and Lombardy, in 1536, he moved to Milan. This may account for the little honour he has received, as so much of his decadent work is in Milan, and his finest productions are to be found only in the province.

We will now see some of the frescoes at Varallo, belonging to his first great masterpiece, the screen across the church at Santa Maria delle Grazie, in that town. Later on we shall see how completely modern he becomes, but in these early frescoes he shows a last lingering feeling for the older and more archaic forms of artistic expression. Here we see it in the peculiarly long and statuesque figure of St. Joseph; but the flowing draperies of the angels already denote a greater freedom of treatment. The face of the Madonna is particularly beautiful. I wish to point out the peculiarly long fingers which we only find in Gaudenzio's early work. Another fact, I think, is very striking, and that is that in these early works he deals with these familiar subjects in so original a manner that we are rarely reminded of any contemporary pictures of similar scenes.

This represents the raising of Lazarus. I think it is one of the finest of the series. Here, again, we notice the extraordinarily long fingers, but in spite of the exaggeration

in the drawing, like all really great masters, Gaudenzio conveys an immense amount of expression by the action of the hands. The fine attitude of Christ, and the kneeling forms of Martha and Mary, make a beautiful group. Altogether I look upon this fresco as the most sympathetic representation of this subject in Italian art.

Christ Before Caiaphas.—The moment chosen is evidently when "one who stood by smote Jesus with the palm of his hand, and said: 'Answerest thou the High Priest thus!'" The head of the man seizing Christ's arm from behind recalls the head of Judas in Leonardo da Vinci's Last Supper. The Roman soldiers in their decorated armour remind us of the school of Mantegna. I daresay you have noticed rather a trick of Gaudenzio's, that he is fond of placing one or two tall figures in the immediate foreground to emphasise the perspective and to give the feeling of space between the spectator and the principal figures.

We see it emphasised almost too much in the following fresco of Christ before Pilate, which is one of the most interesting of the series. Gaudenzio has obviously chosen the moment when Pilate is trying to save Christ, and the crowd are calling for Barabbas. Pilate's face, with its angry puzzled look, as he faces the violent mob, is a masterpiece of expression. In this scene the perspective runs riot, and Barabbas is certainly on too large a scale.

You will notice over the doorway a representation of the Laocoon. It is from this that some writers hold that Gaudenzio must have been to Rome; but I do not think it proves it either way. You, no doubt, remember that the Laocoon had been found a few years previously (in 1506), and the discovery of such an important piece of sculpture was naturally of great interest to the art world of the day. The Renaissance artists had an intense reverence for classic art, and often reproduced well-known pieces of sculpture in their pictures accurately drawn. I think that if Gaudenzio had seen the Laocoon he would have reproduced it more correctly, and I imagine he simply drew it from a description.

Between these frescoes which represent the best work of his first period, and the following pictures, we shall find a great difference. Sixteen years have passed, and not only has his genius reached its full maturity, but his technique and composition have become thoroughly modernised. We know that he occasionally worked at Novari, Vercelli, and other places during this period, and I cannot help thin[k] he must have visited Parma, and studied works of Correggio. This is the only wa[y] can account for the complete change we fi[nd] his work. He still keeps his own fine qual[ities] but the introduction of little cherubs and cl[...] point to, not only an acquaintance with, [...] distinct study of Correggio's methods, whil[e] drapery held back reminds one of Raph[ael's] Madonna di S. Sisto, which, as you no d[oubt] remember, was painted for a church at Piace[nza] so that on his way to Parma he could [have] seen it. But, as usual, he adapts to his [...] art the special qualities of other artists, [...] never slavishly imitates.

This is the altar-piece in the R. Transe[pt of] the Church of San Cristofero, at Vercelli, w[hich] contains some of Gaudenzio's finest works [...] this picture we find the scheme of light [and] shade which we often find in Correggio's w[ork], namely, a dark background and a so[rt of] search-light turned on to the group from [the] front. The Madonna holds the child, who sm[iles] at his own counterfeit on St. Christoph[er's] shoulder. There is something very real [...] and natural about these little children [...] are of a sturdier build than Corregg[io's] cherubs. Some are playing, holding bac[k the] curtain, or eagerly studying a scroll, w[hile] below, two dear little fellows make musi[c at] the Madonna's feet. The monk kneelin[g on] the left represents the founder of the monas[tery], while on either side of the Virgin stand [St.] John the Baptist and St. Nicholas of [...] The other figure is probably a portrait of [one] of the Frati.

The frescoes in this transept were painte[d in] honour of St. Mary Magdalen, and repre[sent] scenes from her life. This represents [the] preaching of the Magdalen at Marseilles. [In] the background we see her preaching on [the] steps of a building, and to the left recei[ving] people who are disembarking, apparently ju[dg]ing from the costume, the same couple [who] are kneeling in the foreground. The Magda[len] with her little group of workers to the righ[t is] exhorting the kneeling figures of what is [ap]parently a family group. These are said t[o be] members of the Liguari family at Vercelli, [and] are admirably painted with that fine bold to[uch] which we associate with the art of Velasq[uez] in the past and of Mr. Sargent in the pre[sent] day. They are well modelled, and the life [and] animation on the young man's face is [...] contrasted with the quieter, calmer expres[sion] of the older faces.

In the same transept we find Gaudenz[io's]

t "Crucifixion." The group of the faint- Virgin, the figures of the Magdalen and John, the callousness of the Roman ers, the fine figure of the repentant thief, show a wonderful richness of invention, y look and gesture of the many figures ing to heighten the effect of the scene. soldier to the right wears the huge head- s and feathers that we find in German ures of this century, and serves to remind hat the Battle of Pavia, two or three years iously, had made the Emperor Charles V. ter of the north of Italy, and the Milanese tory was overrun by his troops. This was ably painted from some German commander oned at Vercelli, and his gay plumes, red d, and shining armour make a fine bit of ur. To the left we have the portrait of re Angelo Corradi, one of the two brothers hose expense these frescoes were executed. he frescoes in the L. Transept were painted onour of the Madonna, with scenes from life.

this nativity there is much that is similar he one at Holford-house, which was lent to Exhibition at the Burlington Fine Arts Club years ago. The centre group is practically same, but I consider this Madonna far more utiful. The fine head of the old shepherd the reverent expression on the young, un- h face behind him are admirably executed.

he Adoration of the Magi.—This animated rather complicated group has given another ortunity of introducing fine portraits of les accompanied by their retinues, and also depicting robes of gorgeous colouring such Gaudenzio revelled in. It is also interesting showing the customs of the time by the oduction of dwarfs, pages, and falconers. page at the back is holding a monkey.

he Assumption of the Virgin.—This ure was commissioned by another of the radis in November, 1532, and Gaudenzio ked with so much zeal that he finished it y in the spring, and received 80 gold scudi payment.

his is by far the greatest picture of this ject, for great as is the "Assumption" of an, this is as great in composition, and far ater in the intense and subtle qualities of ression. The Madonna floats upwards, wn by an irresistible force, surrounded by ng angels, and irradiated by the light from ve, while below on the earth stands the ostles, drawn on a slightly larger scale to phasise the distance from the group above. e compare this group with that in Titian's work there can be no doubt of the superiority of Gaudenzio's art. The faces are full of awe and wonder, reverence, and sorrow, while the play of the hands is most remarkable.

This is the detail of Madonna. It is not easy to find words to describe the wonderful expression on her face, and it is the spiritual atmosphere in this great masterpiece which is the difference between this and Titian's work.

We now come to a few details from the Choir of Angels at Saronno, Gaudenzio Ferrari's last really great work. His fame had by this time spread far, and we hear of artists commissioned to go and copy the frescoes at Vercelli for other churches. In 1534 he was invited to paint the cupola of the Church of Santa Maria dei Miracoli at Saronno. On the 28th September, 1534, Gaudenzio met the Commissioners at Milan, and agreed to go and paint the cupola eight days after Easter in the next year. He was to receive in payment 200 gold scudis, as well as lodgment and the necessary wine for himself and assistants during the time the work lasted, and he was to be fined 50 scudis if he did not begin the work at the given date. However, he kept to his contract, and finished it by the autumn, when he returned to Vercelli.

As we stand under the cupola at Saronno, and look up at this busy throng animated with a holy joy, we can but marvel at the astonishing vitality and movement, and it almost seems as though we *hear* the rustle of this swarm of angels. The intense excitement and tension of feeling shown in every face, the energetic and heart-whole devotion of each single angel to its own particular function in this vast throng, the whole painted with a strength, a simplicity and a directness, which combined make of this cupola one of the finest works of art in Italy.

This detail enables us to see more clearly the fine qualities of Gaudenzio's work and the wonderful vitality in each figure. The varied kinds of musical instruments are very curious and most effectively introduced. The delightful curves of the one held by the angel to the right help to emphasise the flow of the drapery. One instrument seems to be a mixture of a flute and a violin. I do not know if such an instrument exists now, but the instrument in the next picture is certainly familiar to us all as the bagpipe. This graceful and dignified figure is the most beautiful in the throng, and with this we will take our leave of Gaudenzio Ferrari.

His pupil, Lanino, said he ranked amongst the seven greatest painters of the world, and

whatever we may think of this opinion, Gaudenzio Ferrari certainly deserves a high place among the great masters of Italy, that wonderful country which, after supplying all the museums in the world, still remains herself the richest Art Treasure House of all.

DISCUSSION.

The CHAIRMAN said Miss Halsey had taken them on such an interesting tour, and had shown such interesting pictures, that they would all regret that the paper had not been longer. There should have been a painter in the chair, but in his absence he had been called upon to fill the position, though he was not an expert in old masters. He did not know that the paper was one which invited much discussion, but they would be glad to hear any one who had anything to say on the subject. His own position with regard to the old masters was rather to believe all that he was told by an expert, until he was told by another expert (which usually happened) that it was all wrong. As none of these rival experts appeared to be present, he would at once propose a hearty vote of thanks to Miss Halsey for this admirable paper. It had interested him very much and called up memories of things he had seen, although he had not seen many of those which had been referred to. The picture of Sigismund recalled days spent at Rimini, where was that wonderful temple of the Malatestas, which was also rather an unknown masterpiece, and full of unknown masterpieces in the shape of low relief sculpture, well worth a journey to see. To anyone who was going over the ground suggested by Miss Halsey, he should say, certainly do not omit to see what is now called the Cathedral of Rimini. It was well worth coming that evening to see the head of Christ attributed to Giorgione. He said attributed because experts were by no means of one mind about that artist's work—they might agree that only seven or eight works by him existed—but not as to which were the same seven or eight. The dome decoration by Gaudenzio was also very beautiful. They ought to be grateful to Miss Halsey, not merely for showing the pictures and speaking so sympathetically about them, but also for giving the map, and explaining how the various places were to be reached, and giving very useful information with regard to the inn accommodation. He remembered once going on a pilgrimage chiefly in consequence of reading an article by a lady about it. He was delighted by what he saw; but at Urbino the inn was so terrible that he had to leave in hot haste; and he was afterwards told that the author of the article herself nearly died there. It had been a great delight to see the views because they conveyed more to the mind than any ar[...] of description. He himself for example was espe[...] interested in decoration and ornament, and altl[...] that was not the subject of the paper, he had[...] specimens which would incite him to go an[...] the originals. He concluded by formally prop[...] the vote of thanks.

Mr. PHILIP NEWMAN remarked that it was [...] unusual, although not unprecedented, for a lady t[...] a paper there, and he therefore regretted that [...] was no discussion; and all the more, because h[...] sure this paper would last in their memories, as [...] in the annals of the Society. He was certain h[...] echoing the sentiments of all present in saying[...] they had had a most delightful evening's entertai[...] of the most intructive character. If he made any[...] ment on the paper it would be to remark o[...] admirable restraint with which Miss Halsey[...] administered her tender and reverential critici[...] the various works as they appeared. For a la[...] the present day to show such an appreciation o[...] works of the Italian school, reminded one o[...] days when Mrs. Jameson was writing, and i[...] a very pleasant reminder. He could not add[...] thing from his own knowledge of any unfa[...] masterpieces, but he quite agreed in the criti[...] passed on Gaudenzio's work in comparison [...] Titian's. He had seen Titian's work, but ha[...] seen Gaudenzio's. Being, like the Chai[...] associated with decorative work, these pi[...] appealed very strongly to him, because, in the ab[...] of colour, the effect was mainly produced by line[...]

The vote of thanks was carried unanimously[...] the meeting adjourned.

Miscellaneous.

THE AGRICULTURAL PRODUCTS [...] NORTH CHINA.

The principal provinces in Northern Chin[...] Chihli and Shantung. The province of Shansi t[...] west is separated by a range of mountains from C[...] and the climate is in some respects quite diffe[...] but there is a general similarity between the re[...] specially mentioned and the remainder of the nor[...] part of the Empire. The country has an alluv[...] loamy soil, and is usually capable of producing [...] crops when there is an adequate rainfall, which, [...] ever, not infrequently fails. At such times th[...] always a risk of a general famine, such as took [...] in the years 1877-78, when millions perished. Pe[...] the most important crop is wheat. It grows all [...] Northern China, with but slight differences in m[...] of cultivation, due to local climate. In a few

spring wheat is grown; but as a rule the ground ›ughed for wheat in the autumn after the other ; have been harvested, and as soon as there is a fall of rain. The wheat is put in with a drill, as lmost all other crops. The United States Consul entsin says that the Chinese are very expert in the of manure, which they dry in the spring and pul- ; and it is always for sale at the river markets at ice varying with the locality. This manure is ght to the fields in carts, and is poured into the drill so as to make a little go a great way. Much e land is made to yield two full crops a year, and the wheat has been gathered in June, the land be planted in beans or sweet potatoes, maize, or other late crop. The wheat usually ripens t the beginning of June, when the stalk is either d up by hand, or the straw cut (with a small not more than 4 inches in length) very near the The Chinese threshing floor is the centre of sant activity after the wheat harvest begins. The nd has been previously prepared by wetting and g with heavy stone rollers over straw, by which is it is made at once hard and smooth. The t is threshed out by the passage of the stone over it, and the winnowing is generally done y mill—although the Chinese have such an im- ent without screen—but by throwing the grain haff into the air with shovels, by which crude ess much of the chaff is eliminated—at least a ient amount to satisfy the Chinese demands. The mass of the village population do not use white as an article of ordinary diet; but on feast days, g the wheat harvest itself, and during the new s holidays, there is a marked exception to this Next to wheat, probably the most important crop is millet, of which an enormous quantity is n everywhere. White rice does not grow in hern China. It is found in Tientsin and Pekin, not to any extent in the interior. Millet is ed as early in the spring as the rains will allow. drilled into the ground, worked by ploughing een the rows while it is small, and later by g. The Chinese hoe is a clumsy implement. s a surface more than six inches square, and it is to cut weeds in two and to stir the soil from ath, without to any extent removing it. The gh is always small, with but one handle, and it is ently drawn by men and women. No China- has any conception of such a thing as deep ghing, and he would be horrified at the idea of ng all the valuable surface soil underneath. t is called "tall millet" bears no relation what- to the grain last mentioned. It is very similar to orghum, or sugar-cane, so extensively grown at time in the Middle and Western States of rica. It is planted about the same time and r the same general conditions as millet, but it s to from 10 feet to 15 feet in height. The es call it "collian." In this plant, Nature has shed one of her best gifts to the forestless plains orthern China. The blades are stripped from the stalks while green and cured for fodder; when ripe, the tops are threshed for grain. The stalk of the sorghum is so full of silica, that it is invaluable for making hedges and for the roofs and sides of buildings. When used for the latter purpose, the stalks are covered with very thick layers of mud, and withstand the heaviest rains for a long time. When they finally rot, they can be removed, and what is left is used for fuel. Finally, after the stalks are cut and removed from the fields, the roots are pulled up and stored away for fuel, and thus every vestige of the plant is made to serve some useful purpose. Indian corn has been introduced into China during the present dynasty, and it is now thoroughly established as one of the standard crops of Northern China. Barley is grown to some extent, but the aggregate yield is probably not large. Oats are found in the regions of Chihli, about Kalgan and in various parts of Shansi. Besides the millet already mentioned, other kinds are grown, such as the glutinous millet, usually cultivated only in small patches for home consumption. In the many regions subject to inundations there is a kind of upland rice, which is planted when ordinary crops would be swamped, but this belongs rather to Central China than to Northern China. Sesame is grown to some extent for the manufacture, by a rude process, of an oil much used for cooking. Sesame seeds are used to improve the flavouring of the ordinary wheat cakes, baked in ovens or on hot stones. Sweet potatoes are found throughout the whole of Northern China, sometimes of an excellent quality. They are, perhaps, the cheapest form of food accessible to the poor, and are easily cultivated, being propagated from shoots set out after the rains have begun. Tobacco is another plant which China owes to the West, although that fact has long been forgotten. It cannot have been introduced more than two hundred years, but its use has been practically universal. Foreigners think it too mild, but the Chinese are attached to it. It is smoked in long pipes, holding very small quantities. The Chinese grow a great amount of beans of various kinds, the principal of which is a coarse black bean, given to animals, and used for making a crude oil which is in great demand. The bean cake left after the oil has been extracted, is an important article of commerce, especially from the port of Niuchwang, where beans occupy a large part of the cultivable land. The cake is sent to the South, where it is greatly prized as a manure for sugar cane and for other crops. The peanut is extensively cultivated throughout Northern China. It flourishes best on sandy soil, of which there is an unlimited supply. Opium is grown in considerable areas in various parts of Northern China, but statistics of the production are not available. None of the crops thus far mentioned are of greater importance than cotton, which is found in certain districts. It grows on the light soils, but not on the dark ones, and occupies a very important place in Chinese economy. If the spring is a particularly dry

one, the cotton crop cannot be planted at all; or if it is put in, the lack of rain may destroy all the seeds. A year in which there is an amount of moisture sufficient for the grain crops is too wet for the best cotton; and, on the other hand, a year when food crops are a failure, may be a good one for the great staple. The cotton plant is very unlike the stalwart growth of the cotton states of America, being often only a foot or more high. The boll is not much larger than a walnut, and the amount of the staple in each is trifling. Yet almost all the clothing for the hundreds of millions of the Chinese race has come from this insignificant source. Most of the processes through which the cotton is put before it is ready to be worn, bear a marked resemblance to those in use in western lands a hundred years ago. The gin is a clumsy little machine, in which two rollers press upon the cotton to squeeze out the seeds. It is not ideally effective, but it is a fact that expensive foreign devices for the same purpose have frequently totally failed when tried with Chinese cotton. The "scrutching" is done by means of a taut bow, upon the string of which the fibre is snapped dexterously. The manufacture of cotton is at present in a transition state, owing to the general introduction of Japanese, Indian, and more recently Chinese machine spun yarns, which, while much less durable than those made in the old way, are so much cheaper, that millions of women, and men also, are deprived of what previously afforded them a small, but certain income. In conclusion, the Consul says: "Chinese agriculture, like everything Chinese, illustrates the talent of this race for doing almost everything by means of almost nothing. They fatally lack initiative, but if new methods are forced upon their attention, they may be persuaded to adopt them, and once having done so, they will not again give them up. Efforts to introduce American cotton and other foreign seeds have generally been a failure, owing to the reluctance of the Chinese to use them, and especially to the fact that the seeds themselves do not produce the results which they did in their native soil."

THE FLAX INDUSTRY OF COURTRAI.

The town of Courtrai ranks second among the commercial and industrial centres of the province of Flanders, and at the commencement of 1898, had a population of 33,128. Consul General de Courcy Perry states that the exceptionally favoured situation which Courtrai occupies on the banks of the river Lys, in the midst of the flax retting district, is certainly the main cause of the town's prosperity, but in addition to the flax trade, other important industries exist in Courtrai and its neighbourhood, and give the whole district a character of brisk and flourishing business activity. The success which attends the manufacture of flax at
Courtrai may be attributed in a great meas
certain properties possessed by the waters
river Lys which imparts to the flax a rema
fineness, or spinning quality, combined wit
treme tenacity. The peculiar virtues with
nature has endowed this stream would app
have baffled scientific research. Continuous
have been, and are being made by scientific m
pecially in Russia, to ascertain the nature
chemical components to which the Lys ow
rare qualities, but their endeavours have
proved unavailing. This sluggish and appa
insignificant river thus possesses what ma
called a unique monopoly, and on account
great benefits it confers upon the district th
which it flows has been well styled the "G
River." The special properties of the Ly
not extend throughout its entire course, bu
confined to that portion of the stream which
between Comines (Pont Rouge) and I
(Barrierè d'Astère). From Comines to Men
Lys flows midway between the North of F
and West Flanders, but it is between Menin
Vine St. Eloy that the retting is princ
carried on, and at Wevelghen, half-way be
Menin and Courtrai, the industry reaches it
minating point. The demand for flax prepar
the Lys has greatly increased during the
ten years, and the amount of fibre brough
treatment in that river becomes annually l
The local crop no longer suffices to meet p
requirements, and immense quanties of flax
from foreign countries, especially Holland
France. Of late years small consignments o
have also reached Courtrai from the Arg
Republic. The quantity of flax straw rett
the river Lys last year was estimated at
90,000 tons. Some 12,000 to 15,000 lab
were employed during the six months from
15 to October 15—that is to say the season
ing which retting takes place. After the r
processes are finished, the flax is stored in
and sheds until winter, when the scutching, t
cleaning the fibre of the woody parts, takes
This was formerly all done by hand, but at
sent steam-power is greatly used, and mu
also done by a sort of treadmill. About
tons of scutched flax were sent in 1898 to
Britain and Ireland, the greater part going t
latter country. Other countries, such as Ger
Austria, Russia, France, and America receiv
remaining portion of the flax exported.
Belgian spinning mills also take a small qua
During the 1896-97 season, which may be
as an average year, the value of the flax exp
from the Courtrai district was 30,000,000 f
(£1,200,000). The shipments for Great B
and Ireland take place through the port of G
by the direct Ghent-Belfast route and other
lar lines. It is a curious fact that alth
Courtrai excels pre-eminently in the retting

ng of the flax fibre, spinning is carried on only to a very limited extent. Weaving has carried on since an early date at Courtrai, in former times the name of the town was ified with some of the finest woven fabrics e world. This industry is still actively carried The old method of hand weaving still shes, but a large quantity of fabric is also ıced by the mechanical process. Machine ing was founded many years ago in the trai district, but its extension and develop- were somewhat slow, but ten years ago, a derable number of manufacturers interested in weaving realised that in certain branches of industry the struggle against mechanical pro- was hopeless; consequently they yielded to stress of circumstances and founded large and equipped machine-weaving establishments have steadily prospered up to the present . The number of machine-weaving factories ıe Courtrai district now amounts to about 20; number making use of the old hand loom :m is however much larger.

GERMAN COMMERCIAL MUSEUMS.

n Oriental commercial museum has lately been ıed in Berlin for the double purpose of establish- ı permanent exhibition of samples, on the plan of Philadelphia Commercial Museum, and of acting ı chamber of commerce in facilitating trade reen Germany and the East. This sample ware- se brings under the notice of the German public agricultural and industrial productions of Eastern ıtries. The United States Vice-Consul at Frank- says that a complete library and reading-room, aining literature and newspapers from the East, at the disposal of merchants, manufacturers, and others interested. A bureau of information is attached, the object of which is to give instruc- and reliable information about business, firms, the peculiar conditions of various trades in the ent. The work of this bureau is to constantly ch the markets of the different Eastern countries, gather and study the confidential reports which sent in by its numerous staff of merchants and l correspondents in those countries. The new erprise publishes a paper called *Oriental Corre- ndence*, which transmits the latest and most im- tant news from the bureau's correspondents. other publication, issued periodically, called the *ent*, has for its object to foster trade relations, bring about closer connections with the peoples Governments of Oriental countries. This lication is in charge of a gentleman who has, for ıy years past, been attached to the Turkish bassy in Berlin, as dragoman. He is stated to be of the best experts on Eastern affairs and trade ditions. Great expectations are entertained by rman Governmental and commercial circles as to the benefits which will accrue to German export trade from the workings of this museum. The Sultan of Turkey has shown his sympathy by ordering the Imperial Ottoman factories to send a large collection of samples of their products to the museum. The Prince of Bulgaria has done the same, and the Governments of Roumania, Greece, and Servia are expected to follow the example of the Sultan.

CULTIVATION OF COFFEE IN INDIA.

At the end of 1898 there were 281,570 acres of land under coffee in India, all with the exception of 549 acres in Southern India. The cultivation of coffee is in fact restricted for the most part to a limited zone in Mysore, Coorg, and the Machas districts of Malabar and the Nilgiris. About 45 per cent. of the coffee-bearing area is in Mysore, where there were 128,079 acres in 1898. The plant is grown on 128,410 acres, forming another 45 per cent. in the British districts of Coorg (82,575 acres), the Nilgiris and Malabar (45,835 acres). If to these two areas are added 6,384 acres in Travancore and Cochin, we find 93 per cent. of Indian coffee concentrated in the elevated region above the south-western coast. Mysore, Coorg, and the Madras districts contain 97 per cent. of the coffee-growing area. According to the United States Consul at Bombay, in the Madras Presidency, cultivation on an extended scale is confined practically to the two districts already mentioned, and to Salem and Madura. The only other province in which coffee is grown, except experimentally or to an insignificant extent, is Burma, and the cultivation there, mostly in Toungoo, is very limited. The area in Madras, after a reported contraction in 1896 and 1897, again expanded in 1898 to the level of 1894 and 1895. In Coorg, the area reported in each of the last three years is much beyond the average, but in Mysore it has been reduced approximately to the level of 1892. As regards the production of coffee, the yield in 1898 was about 23,750,000 lbs., that of 1897 having just exceeded 24,000,000 lbs. The production of both years was exceedingly poor, following a small yield in 1896. The poverty of the crop in 1896 and 1897 was due in the main to adverse seasons in Mysore, Coorg, and Travancore. In all three cases there was a recovery in 1898, which was, however, incomplete in the case of Mysore, but to set against this recovery the Madras crop was a signal failure. Since 1897, the fall in prices has removed the stimulus which had been given for a few years to the expansion of the coffee-growing area, and disease has combined with adverse climatic conditions to reduce the yield. According to returns there were in 1898, 25,930 persons employed permanently, and 88,550 temporarily, on the coffee estates, making a total of 114,480 persons, which is equal to one person to 2·46 acres.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MAY 9.—"Improvement of our Roads." By A. MORESBY WHITE. SIR JOHN WOLFE BARRY, K.C.B., Chairman of the Council, will preside.

MAY 16.—"A National Repository for Science and Art." By PROF. FLINDERS PETRIE.

MAY 23.—"Salmon Legislation." By J. WILLIS-BUND.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I.

FOREIGN AND COLONIAL SECTION.

Tuesday afternoons at 4.30 o'clock:—

MAY 28 (MONDAY).—"Imperial Telegraphic Communication." By SIR EDWARD SASSOON, Bart., M.P. The Right Hon. SIR HENRY H. FOWLER, G.C.S.I., M.P., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MAY 8.—"Art Metal Work." By NELSON DAWSON. HENRY H. CUNYNGHAME, C.B., will preside.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

Prof. VIVIAN B. LEWES, "The Incandescent Gas Mantle and its Use." Three Lectures.

LECTURE I.—MAY 7.

The History of Incandescent Gas Lighting.—The discoveries that led to the mantles of to-day—The oxides suitable for mantle-making and their preparation—The services of thoria and ceria, and the methods adopted for their extraction.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 7...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. Vivian B. Lewes, "The Incandescent Gas Mantle and its Use." (Lecture I.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Brierley Denham Healey, "The Economical Disposal of Town Refuse."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Dr. W. Newton, "The Production of Nitrate of Soda in Chili."

British Architects, 9, Conduit-street, W., 8 p.m. (Annual Meeting.)

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. The Ven. Archdeacon Sinclair, "A Divinity."

TUESDAY, MAY 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Nelson Dawson, "Art Metal Work."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. H. R. Mill, "Studies in British Geography." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 Mr. Chapman Jones, "The Effect of Colo Gradation."

Zoological, 3, Hanover-square, W., 8½ p.m. 1 G. A. Boulenger, "A List of the Batrachian Reptiles of the Gaboon (French Congo), Descriptions of new Genera and Species." 2 W. R. Ogilvie Grant, "The Birds of Hai 3. Mr. Philip Crowley, "The Rhopalocera lected by the late Mr. John Whitehead i Interior of the Island of Hainan."

Colonial, Whitehall-rooms, Whitehall-place, 8 p.m. Mr. Allister M. Miller, "Swaziland."

Asiatic, 22, Albemarle-street, W. 3 p.m. A Meeting.

WEDNESDAY, MAY 9...SOCIETY OF ARTS, John-s Adelphi, W.C., 8 p.m. A. Moresby White, " provement of our Roads."

Geological, Burlington-house, W., 8 p.m.

Japan Society, 20, Hanover-square, W., 8½ Miss E. R. Scidmore, "Asagao, the Mo Glory of Japan."

Royal Literary Fund, 7, Adelphi-ter., W.C., 3

Iron and Steel Institute, 25, Great George-s S.W., 10½ a.m. Annual Meeting. Selectio following papers to be read and discuss (1) "Ingots for Gun Tubes and Propeller Sh by Mr. F. J. R. Carulla; (2) "The Manufa and Application of Water-Gas," by Mr. Dellwik; (3) "The Equalisation of the Tem ture of Hot Blast," by Messrs. Lawrence and Joseph H. Harrison; (4) "Blowing-En driven by Crude Blast-furnace Gas," by M Adolphe Greiner; (5) "The Solution Theo Iron," by the Baron H. von Jüptner; (6) " Use of Fluid Metal in Open-hearth Furnaces Mr. James Reilly; (7) "The Manganese Or Brazil," by Mr. H. Kilburn Scott; (8) " Utilisation of Blast-furnace Slag," by the F Cecil von Schwarz; (9) "Iron and Phospho by Mr. J. E. Stead; (10) "The Continuous W ing of the Open-hearth Furnace," by Mr. B min Talbot.

THURSDAY, MAY 10...Electrical Engineers (at the Hou THE SOCIETY OF ARTS), 8 p.m. Mr. S. Ever "A Frictionless Motor Meter."

Antiquaries, Burlington-house, W., 8½ p.m.

Iron and Steel Inst., 25, Great George-street, S 10½ a.m. Annual Meeting. Reading of p and discussions continued.

Royal Institution, Albemarle-street, W., 3 Prof. Dewar, "A Century of Chemistry a Royal Institution." (Lecture III.)

Mathematical, 22, Albemarle-street, W., 8 p.m.

FRIDAY, MAY 11...Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting, 9 p.m.

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlin house, 5 p.m. 1. Discussion of Prof. Lo paper on "The Controversy concerning V Contact Force." 2. Mr. J. B. Tayler, "The of Formation of Alloys." 3. Dr. Gladstone, " want of Uniformity in the Action of Copper- Alloys on Nitric Acid." 4. Prof. S. P. Thomp "An Electromagnetic Experiment, and Ex ments illustrating the Aberration called Com

SATURDAY, MAY 12.. Botanic, Inner Circle, Regent's- N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 Professor Stanley Lane-Poole, "Egypt in Middle Ages." (Lecture III.)

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FRIDAY, MAY 11, 1900.

' communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

THE ALBERT MEDAL.

The Council of the Society attended at arlborough House, on Tuesday, the 8th st., when His Royal Highness the Prince of ales, K.G., President of the Society, presented the Albert Medal of the Society to Sir illiam Crookes, F.R.S., "for his extensive d laborious researches in Chemistry and in ysics; researches which have, in many stances, developed into useful practical plications in the Arts and Manufactures."

ie members of the Council present were:— John Wolfe Barry, K.C.B., F.R.S. (Chairan), Sir John Evans, K.C.B., F.R.S., Sir arles Malcolm Kennedy, K.C.M.G., C.B., Edwin Durning Lawrence, Bart., M.P., Westby B. Perceval, K.C.M.G., Sir Owen berts, M.A., D.C.L., Sir Thomas Sutherid, G.C.M.G., M.P., William Luson Thomas, d Prof. John Millar Thomson, LL.D., F.R.S., th Sir Henry Trueman Wood (Secretary), d Henry B. Wheatley (Assistant Secretary).

CANTOR LECTURES.

On Monday evening, 7th inst., Professor VIAN B. LEWES delivered the first lecture of s course on "The Incandescent Gas Mantle d its use."

The lectures will be printed in the *Journal* iring the summer recess.

APPLIED ART SECTION.

Tuesday, May 8, 1900; HENRY H. CUNYNG-AME, C.B., in the chair. The paper read as "Art Metal Work," by NELSON DAWSON.

The paper will be printed in the next number the *Journal*.

CONVERSAZIONE.

The Society's *Conversazione* will take place at the Natural History Museum, Cromwell-road, S.W. (by permission of the Trustees of the British Museum), on Wednesday Evening, the 20th June, from 9 to 12 p.m.

The following portions of the Museum will be open:—On the Ground Floor—the Central Hall, British Saloon, and the Fossil and Mammalia and Reptilia Galleries; on the First Floor—the East and West Corridors.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the *Conversazione*. On that day the price will be raised to 7s. 6d.

These tickets will only be supplied to persons presenting members' vouchers (which can be obtained from the Secretary) or a letter of introduction from a member.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

TWENTIETH ORDINARY MEETING.

Wednesday, May 9, 1900; SIR JOHN WOLFE BARRY, K.C.B., F.R.S., Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Armstrong, Frederick, British Consulate, Milan, Italy.
Engleheart, Sir J. Gardner D., K.C.B., 28, Curzon-street, Mayfair, W.
Jones, Frederick William, Barwick, near Ware, Herts.
Pinkerton, Surgeon-General John, M.D., Queen's-park-house, Langside, Glasgow.
Seymour-Jones, Alfred, Pendower, Wrexham.
Whittall, Sir James William, Constantinople, Turkey.

The following candidates were balloted for and duly elected members of the Society:—

Adams-Randall, Charles, 5, Salters'-hall-court, E.C.

Anderson, Frederick, care of Ilbert & Co., Shanghai, China.
Delgado, Gershom, 17 and 18, Paradise-street, E.C., and 256, Gloucester-terrace, W.
Galloway, Professor W., Cardiff.
Getting, James Charles, 4, Corbet-court, Gracechurch-street, E.C.
Masson, William Pulteney, River-view, Darjeeling, India.
Pease, Henry T., Veterinary-Captain, Veterinary College, Lahore, India.

The paper read was—

THE IMPROVEMENT OF OUR ROADS.

By A. Moresby White, F.R.G.S., F.R.H.S., Barrister-at-Law.

It is advisable to state at the outset why I, though not an engineer, am reading a paper on the subject of roads. The enormous increase in the use of cycles in the metropolis has led to a growing and increasingly strong demand for a local body to unite and protect the interests of all wheelmen in and around London. Last year, with the earnest assistance of a few, we started the Metropolitan District Association of the Cyclists' Touring Club. The committee of this association, of which I have the honour to be the chairman, has quickly taken vigorous action, already bearing fruit in such matters as the removal of cycling restrictions in Hyde-park, and the granting of additional facilities by railway companies, and has taken up the question of better roads. With the object of improving the disgraceful condition of most roads in and near London—of which the Thames Embankment and Regent's-park are notorious specimens—the Metropolitan District Association has opened a subscription fund, and we are sanguine that when our objects are widely known and appreciated, we shall have a ready response from all cyclists. The best method of using our resources is a matter on which we cordially invite suggestions. At present our idea is to pick out a section of chronically bad road, something more than temporarily defective, and to employ a leading engineer, whose name will carry weight, to report on it, stating what ought to be done, and at what cost. This report, with a petition signed by residents and cyclists, will be presented to the highway authority, and with the assistance of the Press something may be achieved. After the initial difficulties are overcome and we have got a few lengths of road properly attended to, a[nd] established our right to be recognised as [a] body gratuitously working for the pub[lic] welfare, subsequent developments will be eas[y].

We believe that there ought to be a [re]cognised class of good roads, or, at least, th[at] the standard of road construction should [be] very much higher than it is now. As cyclis[ts] we know what we want, and, as citize[ns] we are anxious to advance our ideas in [a] temperate and practical spirit, therefore [we] now seek for advice, for suggestions, a[nd] assistance from eminent authorities like [Sir] John Wolfe Barry, Sir Alexander Binnie, a[nd] others. With the object of inducing a di[s]cussion here, which will lead to furth[er] publicity in the newspapers, I have consent[ed] to read a paper on this important top[ic]. Leaving to others, more competent than m[y]self, the treatment of details, I pass at once [to] the general heads of the subject.

Roads are to a country as arteries to th[e] human body, for along them flows the li[fe] blood of the country. The better the road t[he] easier the communication, and the more rapi[dly] commerce increases, the greater the prosper[ity] of the nation. We are prone to regard ra[il]ways as our salvation, but without roads th[ey] are useless. In collecting and distributi[ng] their traffic, railways are dependent on roa[ds]. We all want good roads, but a little [un]certainty prevails as to what a good road is. [A] road may be a broken pavement over wh[ich] vehicles pitch and toss like ships at sea, o[r a] track with one foot of sand in summer, a[nd] two feet of mud in winter. Sometimes [it] means a lane decorated with flint and ot[her] quarried curios, or, again, a way casua[lly] repaired with brickbats and broken bottl[es]; the term will easily designate a narrow chan[nel] between high banks smothered in weeds a[nd] vegetation, or an abrasion of the eart[h's] surface as undefined in its limits as the r[ealm] of an old British king.

Good roads there have been in the pa[st]. Pharaoh made them to enable him to build [the] Pyramids. The Incas of Peru, ignorant of [the] use of iron, built roads on which, by relays [of] runners, delicacies for the royal table w[ere] conveyed 200 miles a day. The Carthagini[ans] taught the Romans, who spread a network [of] cross-roads through their dominions so skilf[ully] that Pliny tells us Tiberius Nero drove fr[om] Lyons on his way to Germany 200 Rom[an] miles in 24 hours. The ruins of their splen[did] structures are regarded by the curious a[nd] learned as the fossil remains of a rem[ote]

ological epoch, when conditions existed ferent from our own.

n England, tracks wound a tortuous way oss country, avoiding marshes, even turn- aside for a large tree or a stone, and on ning to a river falling in on one side and nbing out on the other. We are told by w that Maud, Queen of Henry I., lost eral of her attendants in crossing the River a, and she herself was "well washed in the ter of Lea," wherefore she had a bridge lt at Bow, the like of which was never before n in England.

The building and repairing of roads and dges was part of the *trinoda necessitas*, or ee-fold necessity of the Norman period. e parish was always responsible for its ds, and an individual could only be liable particular custom. Such is our law to-day.

The first Highway Act was in 1555, when tute duty was introduced. Statute duty, or tute labour, compelled a parishioner to our on the road four days a year for eight urs each day, with a number of wains, rses, and servants varying according to the mber he owned. Statute duty in altered ms existed until 1835, when, with its many grant abuses, it was finally abolished. omwell anticipated the main points of dern highway law, and substituted hired our for statute duty, but this, like most of far-sighted reforms, perished with him.

In 1662 the width of wheels was provided for d fixed at four inches, and the following year e first turnpike was established, when toll- tes were authorised along the road from ndon to York. The principle of making rsons who used arterial roads pay for their aintenance rapidly developed. In 1706 the st turnpike trustees were appointed; this was the London to Holyhead road. Still the ghways did not improve and the tolls con- ued to rise until the popular disaffection oke out in the Rebecca riots, from 1740 to 50, when many of the toll-gates were burnt. serious was the rising that the death penalty as inflicted in many cases. General turn- ke Acts came into vogue in 1767 and were aracterised by the encouragement of wide res. The wider the tyre the less the toll, and er 16 inches went toll free, as the object was help in rolling and consolidating the road. eanwhile the takings of the tolls were rising om over £500,000 in 1800 to £1,500,000 in 35. Unfortunately through bad administra- on the greater part went into creditors' pockets d the roads sunk from bad to worse. Nor was the application of the Highway-rate more carefully attended to. With the object of easing off the Poor-rate it was subjected to all sorts of claims, for instance, out of the Highway-rate was paid the maintenance of a bastard child because it was found in a ditch by the roadside.

The Highway Act of 1835, now the principal statute on the subject, was designed as a code to replace the repealed statutes. It abolished statute duty, but it retained team labour with the alternative of a pecuniary composition. Team labour was the right of a parishioner to have his carts and horses employed on the road and to be paid for them, but this has gradually fallen into disuse. The Act restored to the parish the right to appoint Highway surveyors, which had been taken from the parish in the reign of William and Mary and vested in the Justices of the Peace. Unfortunately there was no regulation in the Act on the width of wheels.

The immediate result was an improvement in highways, then were the palmy days of coaching. With the development of railways came the decay of roads. Surveyors were appointed who were wholly incompetent, one because he had failed as a farmer, another because he was a member of the church choir. An attempt to reduce the expenditure and improve the road was made by the establishment of District Highway Boards, being a combination of several parishes for highway purposes.

The growth of towns, and the facilities accorded to urban districts by the Public Health Act and the Municipal Corporations Act, led to the improvement of all town roads. Country roads were still neglected. Most of us can remember the defaced milestones, the illegible sign-posts, which used to delude the belated traveller.

The first change came with the powers of the County Council in 1888. Main roads were now properly cared for, and in 1894 bye-roads were handed over to the District Council, the newly-constituted highway authority. The immemorial liability of the parish has now almost entirely disappeared.

The fruits of this new legislation is readily apparent in better roads, in a plentiful crop of new milestones and sign-posts. Nor should we forget the admirable zeal of the Cyclist's Touring Club which has led to safeguarding dangerous hills by the erection of warning notices. Ten years have witnessed a considerable change in matters ancillary to roads, but a great deal remains to be done.

The improvement of roads was defined years ago by Sec. 48 of the Highway Act, 1864, to properly include—

1. The conversion of any road that has not been stoned into a stone road.

2. Widening any road, cutting off the corners in any road where land is required to be purchased for that purpose, levelling roads, making any new roads, and building or enlarging bridges.

3. Doing any other work in respect of highways beyond ordinary repairs essential to placing any existing highway in a proper state of repair.

These powers are ample enough for any highway authority, would that they were more extensively used!

In dealing with the construction of roads, a preliminary observation will convince us of the error of continuing to follow primitive tracks. So tortuous are our country roads that they appear to have been the result of the wanderings of a herd of pigs in search of food. Most of these devious highways are without any foundation, and it costs more to properly repair them than to build and maintain a more direct road. Money spent on such trackways is a total loss, and every year thousands of pounds are literally turned into mud.

The two principal methods of road construction are Telford's and Macadam's.

In both cases the subsoil must first be properly levelled and graded, then well rolled and thoroughly drained. Ingenious machines for grading are used in America, where most of the roads are dirt or earth roads. On this hardened bed comes the foundation of stone.

A Telford road has a foundation of large stones, from two inches to four inches thick, and eight inches to twelve inches long, the interstices being filled with stone chips, and the whole structure consolidated into a pavement. Upon this broken stone is spread, diminishing in size from a three-inch ring to a two-inch ring. Then gravel and stone chips are used as a bonding substance, and the roller gradually unites the whole into a complete structure.

A macadam road is built up of broken stone from its foundation, there is no bottom layer of large blocks of stone. In making the foundation no water should be used, for in all cases the weight of the roller ought to be sufficient and it is essential to keep the foundation dry. The succeeding coats should be watered as the rolling proceeds, the fluid acting as a lubricant and assisting the process of bonding. Water is useful in constructing a road because capillary attraction. We see this in sand the seaside: when wet it will bear a heavy loa when dry the particles move freely over o another, and the lightest of weights will sink the sand.

The whole road should be cohesive, not series of separate skins. In such a road the is more life, more resiliency to the impact the traffic. In many cases, unfortunately, w see materials spread in purposely separat beds, with no attempt at bonding. Earth clay should not be used as binding materia only gravel or stone screenings. The Telfor method is preferable in wet places. Macada in ordinary use is more popular and cheape There is a tendency in a Telford road for th upper metal to be ground between the blow from the traffic and the foundation which ac as an anvil.

To get good stone is not always eas Granite is not, as commonly supposed, th best kind of stone, it is mainly composed feldspar, which is liable to rapidly decompo into kaolin, producing clay, which is a sour of dust in dry weather and mud in wet. Th darker granite containing hornblende instea of feldspar is better. The best material is tra rock. Many kinds of hard field and riv stones will, when properly broken, afford fairl good material. For breaking and distributin stone the Americans employ ingenious an useful machines. The stone-breaking machi usually produces three separate sizes. On advantage of a distributor cart in road buildin is to insure a uniform depth of metal.

The road surface should not be so flat as t hold water and not so convex that wheels sl down the sides, which would tend to throw th traffic into one track along the top and rapid result in ruts. The convexity should be great on hills to prevent the water running down th road, if water-brakes on hills are used th should be in a slanting direction. The surfac of the road must be kept well drained and th water tables cleaned. Gutters through th grass bordering the sides should have bevell edges to save them from being trodden in b passing cattle. Pipes should be periodical tested. It does not improve the drainage entirely clear away the grass border, f unless the vacant earth is metalled over, whic is usually too expensive, it will constantly b brought into the stone road by the feet of pas ing cattle, this means increasing mud an dust. The grass border is a comfort to th foot passenger and grateful to the eye. O

ds ought to be not only useful but pleaıt.

Ieaps of road scrapings or stones should be a safe distance from the hard road.

Che gradient of any properly constructed d should not exceed 4 per cent. Up and wn this grade a horse can trot with safety; n here the pull is twice as much as on the el. Five feet in a hundred is the limit of epness, when it becomes more the load is ited to at least a third of that which can be wn on the level, and the road loses value at e.

The usual method of repairing a country d follows the time-honoured custom of waitr until the surface is a mass of holes and s, and then replacing the damage conquent upon neglect. Such tracks are one y a road, the next a morass. The stone repairing should be carted in dry weather d be well exposed to the air before use; tual repairs are best done in damp weather en the metal consolidates better.

Dry weather soon wears a road, the stones sen and work out, one loose stone quickly ds to more. Loose stones should always removed from the surface at once—the rake the roadman's best instrument in dry ather—they are dangerous to horses' feet and cyclists; when left on the road they are ble to be forced by passing traffic into a mpact piece of surface, which is thereby sintegrated. In the holes they leave the wet rks through and damages the lower stratum. ones used for stopping or scotching wheels hillsides are particularly dangerous in the rriage way. Dust and mud will spoil any ad. A clean surface is more comfortable for e traveller, and more economical in the long n.

Ruts should have the mud cleaned out before ing stoned. It is advisable to stone one rut a time, and all three tracks should never be ned at once. If the material is laid in fferent places, at different intervals, the affic is necessarily spread all over the road d this keeps the surface level; once a visible ack is made ruts very quickly appear. The rm waggons find their own course, the iver usually sauntering alongside with his nds in his pockets, and if there is any sort a track apparent the horses instinctively ke it. Where the traffic goes in different rections the ruts disappear; we notice this at rners, horses take a corner in varying dictions, and the result is a level bit of road; corner is well known to roadmen as an easy place to mend. When the surface requires extensive renewal, it is best to pick out a cross section and carefully remake the whole. For extensive work a roller studded with spikes is useful to pick up the road, but care should be taken to see that the spikes are not long, otherwise the foundation may be disturbed. For all repairs a roller is necessary, and, considering the extensive mileage which nearly all district councils have now to look after, there can be no excuse for the absence of a proper roller. In many cases two or more rollers will be required to cope with the work, and ought to be provided. A horse-roller is undesirable, as hoofs cut up the newly-made binding; a steam reversible roller is the best thing, aud this in urban districts must not exceed 10 tons for fear of damage to gas and water pipes.

As to the width of wheels, there is, unfortunately, no general law. Any county council can make by-laws on this important matter. A two-inch tyre will soon wear away at the side, and become a one-inch tread, which means that the whole load rests upon a bearing surface of less than four square inches. What wonder that ruts result! On most roads traffic has enormously increased, and yet old, narrow tyres are still used! There is no excuse for this, because adjustable tyres are in common use in America, and can be fitted to any sort of wheel. A wide wheel flattens the road, and tends to press in stones when they becomes loose, whereas narrow wheels cut into the surface, and knock loose stones on one side, instead of rolling them in. Broad wheels are also easier for draught.

The question of tractive force exemplifies the true economy of a good road. On an ordinary bad road the tractive force required is double that required on an ordinary good road. The difference is more striking between a macadam road and a dirt or earth road; on the latter four times the force is necessary as compared with macadam.

Experiments with a tractometer prove that on good macadam the change of force alternates within 50 lbs., while on a dirt surface it varies from almost zero to 700 lbs. The latter means a series of violent jerks, which communicate themselves as severe blows to the collar, thus cruelly distressing the unhappy animal. A horse will find it easier to draw one and a half tons on a properly constructed macadam than half that weight on the usual type of rural road. It has been computed that if good roads were generally adopted there

would be a saving of upwards of £4,000,000 a year. This alone would justify the capital expenditure required to give us good roads, while the benefit to the agricultural classes would be inestimable.

The average main road, or urban road, costs about £33 per mile to repair, the figure in France is the same, but there the proportion spent in labour over material is greater. Purely rural roads average about £12 per mile. The United States macadam costs in construction 2,000 dollars a mile, which is less than in England, and in repair half the amount a gravel road does. One mile of road averages about 40 tons of material for repair. There ought to be one man to every four miles of main road at least.

The upholders of the present system seem to delight in employing incapable men at low wages, most of whom ought to be enjoying a well-deserved rest in a home for the aged poor. Practically, it is a form of outdoor relief given in a manner which is altogether wrong. There is a class frequenting workhouses which ought to be made to work upon the roads—tramps and casual loafers; these habitual customers might well be set to tasks on the highway.

The employment of convict labour is already popularised in America, and there seems to be no reason why it should not obtain here. It is not necessary to imagine the unedifying spectacle of convicts working on our main roads with armed warders guarding them. Prisoners who have been convicted of lesser misdemeanours might serve their time in gravel pits and quarries, which could be turned into labour camps. Contact with the public should be carefully avoided. The competition of prison-made goods, of which we hear so much, would cease to exist. There is no probability of any trades' union agitation in favour of the small amount of labour which might be displaced by convict stone-breakers. The displacement, if any, would be trifling, because there must be an enormous increase in the supply of properly prepared material to improve our roads and maintain them with efficiency. A cheap supply of good material would then be available to every highway authority. Those near the quarry should not be allowed the advantage of cheaper delivery, but the cost of delivery should be averaged over the general price, so that a council in a limestone district, or in a chalk country, might be able to obtain good road metal as cheaply as a highway authority situated in the neighbourhood of the best stone. The general improvement in the quality of roads would soon becon marked.

The comfort of the road is an entire neglected quantity, and the cyclist particular feels the absence of a smooth surface and shady track. Tracks of beaten ashes on tl main roads are common in Brabant. The are about 2 metres broad, and are laid on tl earth, being 10 centimetres thick of well beate down ashes; the cost is about £20 per kil metre, which is by no means expensiv Occasionally they are separated from the roa by a low kerb. The better plan seems to l to lay them on the far side of the grass edgin or if laid on the side of the road without ar boundary the foundation ought to be of bricl bats or hard stone to withstand the occasion inroads of heavy traffic. Ashes dry quick than gravel, and are more pleasant for cyclin I see no reason why such paths should n exist on our main roads, all of which a usually 60 feet from hedge to hedge, an consequently afford ample space for the co struction of such tracks.

The English custom of planting hedges b the wayside exposes the road to extremes temperature; while it enables the wet to d off quickly, it lets in all the wind and su with corresponding detriment to the surfac Hedgerow trees with roots permeating the roa and the adjoining land disintegrate th structure of the tract and impoverish the soil from the farmer's point of view they are useles devouring mouths. The best kinds of tree t plant are those that root downwards, the trunks being kept trimmed high up to let i light and air. The chestnut is common i America, and it is beautiful and useful. I Germany we find the cherry, and in France th mulberry tree shading and ornamenting th high road. Such a system in England is quit practicable, and would add enormously to th comfort and joy of the traveller.

The case of urban roads is somewhat mor difficult; frequently we find attempts at ston construction, which may be much admire by geologists in the future, but are useless a traffic surfaces. The ordinary surfaces ar macadam, wood, asphalte, or stone-pavin (such as cobs or sets); the relative expense pe square yard per year is: macadam, 3s.; wood 2s. 2d.; asphalte, 2s.; granite sets, 1s. These are merely rough figures and vary in many places.

The price is not the only thing in favour o stone sets. The wear of macadam exposed to heavy urban traffic is at least four inches per

ar, and, averaged over the whole surface, is less than two inches; all this goes to make st and mud. There is ample room for im-oved treatment in suburban roads. No ubt the want of a proper foundation is re-onsible for the shocking state of most burban roads; it may be so in the case the Thames-embankment itself which is notorious offender.

Wood is insanitary, for the smells from it hot weather are very bad, and when it comes slightly worn it is more awkward an bad macadam. Asphalte easily becomes easy, and it is then a death trap to horses d cyclists. Frequent washing is essential keeping it in proper condition. A most rious objection to its use is the strain upon rses' legs from want of resiliency in the sur-ce. Few people have any idea what force horse exerts in bringing down his feet, and asphalte it is like striking a block of iron, e jar inflicted upon the bodily structure of e animal is painful and ruins its working istence.

Stone sets are too noisy, or to be more curate, the wheels which go over them are noisy. Better than stone sets are basalt ocks, which can be laid so as to form a nooth road; these are a modern introduction om basalt quarries abroad, they wear well thout that irritating convexity which we ually find in each block of stone paving.

Other substances have been tried such as r macadam, which is a good class macadam, e binding material being mixed with tar to nder it impervious to wet and frost, and it said that such a surface gives practically dust or mud.

Brick roads have been tried in America. In onmouth, in the State of Illinois, the earth undation was carefully prepared and evenly cked, then a curb of 2 inch by 6 inch oak ank was set, which gave the required undaries between, then a 5 inch bed of sand as laid and evened up. On this was placed single course of paving brick, which made a e road, the approach to the curb was care-ly graded macadam. Where traffic is very avy on short lengths of road, a track has en laid in two narrow parallel strips, which ake a sort of railway for the wheels, and able heavy loads to be drawn with greater se. This sort of track, composed of stone, frequently found in Italian towns.

The real question of traffic depends more on wheels than upon surface. It is extra-dinary that in these days of engineering triumphs we have not yet got a noiseless wheel. The roar of traffic is merely wasted force, a melancholy thought for every engineer. We must not trust to the prospect of horse-less traffic, nor be allured to reply upon the electric tram, or the seductive guile of a light railway. Think what a noiseless wheel would mean; a peaceful serenity would prevail, even in Gray's-inn-road! Attrition of the surface would be miminised, and consequent expenses of repair become infinitesimal. Think of the enormous conservation of now wasted energy! How clean, smooth, and pleasant might be our suburban streets; heavier loads could be drawn with greater ease, and the sufferings of dumb animals would be alleviated. Where is the engi-neer, where is the benefactor of his species, who will at one stroke practically solve the whole question of better and cheaper roads? Nor should the necessity of an improved horseshoe be forgotten, though when the traction is made easier, the strain on the hoof will be dimi-nished.

The cleanliness of streets is most important, three-fourths of the filth is undeodorised dung, the slightest breeze surrounds a cyclist, who is perforce near the surface, with an accompany-ing cloud of noisome particles. Why should not every horsed vehicle be compelled to carry a bag fixed to the tailboard, so as to intercept the dung and prevent it even getting on the street? They are frequently used in Germany. So simple a precaution is now a sanitary necessity.

The main roads of Belgium teach us what an artery should be, a well-treed avenue, in four distinct parts, the centre the carriage-way, on one side the foot-path, and the cyclist track, on the other the tramway or light railway, which is carefully kept in its proper place at the side of the road. We can only marvel at the insular stupidity which places a tramway, or worse still a light railway, in the middle of a suburban road surrounded by uneven stone sets, and attempts to maintain an even macadam surface around it, the result being invariably an expensive failure, while the passenger has to dodge between vehicles across a muddy road, instead of gracefully alighting from the foot board of the tram-car on to the side walk.

I do not propose that a complete system should be at once introduced; let us begin with permanent improvements, and gradually in-crease the area. Let us waste no more money in mudholes and imitation quarries. A general standard of repair is sadly needed, and a general system of by-laws. The latter are

already enforced against cyclists under the Local Government Act, 1888.

Is not the cyclist entitled to recognition as a citizen? He pays rates and taxes, as a cyclist he is subject to special statutory provision, may he not justly expect more generous encouragement for what is now a national pastime; On every highway the innkeeper welcomes the cyclist, hostelries which, a few years ago, sneered at the man awheel, now hang out the legend, "Cyclists provided for, lock-up stable." In every by-way the cottage offers "Teas," the humble village public-house has become a "cyclist's rest." But where is the welcome of the public authority? what has the highway body done for him, beyond sniffing at him as a grumbling nuisance?

I want to see some of the great powers of the highway authority properly exercised, to see generally enforced by-laws dealing with matters like broken glass, nails, and hedge clippings left on the road. The Middlesex County Council have already made a by-law as to broken glass:—"Any person placing, depositing, or leaving any article of glass, or any broken glass or other sharp substance, not being road material, on any highway or public place, shall, on summary conviction, forfeit and pay a sum not exceeding 40s."

I want to see trees planted along the wayside, cycling tracks on all broad roads, the steam roller at work in the uneven lane as well as on great thoroughfares.

Such amendments in the law are no party question, good roads are essential to our commercial prosperity, cheapness of cost in transit enable us to undersell our competitors. These national matters transcend the narrow limits of party warfare. I confidently believe we shall before long find our main roads well kept avenues, broad and stately, bordered with trees, having separate courses for their ever varying, ever increasing volume of traffic. And every country lane should be firm and smooth, trimly kept, neatly swept, enabling the weary dweller from a great city to journey with comfort and ease through the rural delights a bounteous nature has provided in every nook and corner of England. I look forward with hope to finding in every highway a way of pleasantness, in every by-way a path of peace.

Do not say it is a dream! It is no dream, it is a practicable possibility. True, so great a public good cannot be wrought without much private toil and sacrifice. I appeal to you for helpful suggestions, for kindly criticism, and for practical assistance in your various pub and private vocations. I hope you will use your skill, ability, and influence, to promote object so essential to the common welfa Such an appeal cannot be made in vain, for the task is great, greater is the reward, t heartfelt gratitude of this generation—t blessings of countless generations to come.

DISCUSSION.

The CHAIRMAN said this was a subject which i terested everyone, and the figures given showed h important it was. He did not know how the figur of £4,000,000 was arrived at, but had no doubt the was good reason for saying that that sum could saved annually in the United Kingdom by good road Mr. White said he was not an engineer, but a barrist but if he was as well acquainted with the ruts and pi falls of the law as he had shown himself to be wi those in our roads, he thought he was on his way the woolsack; for few people had given as mu attentive study to the points necessary in roa making. He cordially agreed with the concludi words in which Mr. White invited suggestions, f although the paper discussed drawbacks and failure it hardly informed them how the ideal road was to b made. Every kind of road was represented as more c less of a failure, and he could not say that this wa wrong, for at present we had not producd any kind road which was thoroughly satisfactory. A great pa of the difficulty arose from careless making. In th suburbs, the contractor usually put on the undraine surface what he called "hard core," a collection o old brickbats, mortar, hats, bonnets, sardine tins, an broken bottles, and no one could wonder that any thing put on the surface of that soon worked int holes. The essential to a good road was to tak great pains with it, and the proper way was some thing like that adopted by railway engineers i which the ballast received the most careful atten tion; at the bottom large stones or lumps of sla were employed, then smaller pieces of the same and, lastly, the finer material. Then they spent heavy sum per annum in maintenance, or else th public would be exposed to bumping and jolting instead of travelling in comfort. Nine-tenths of th failure were due to want of care in maintenance. I was comparatively easy to make a good road, but ver difficult to make those who held the purse strings fin the money for proper maintenance. The roller was a very useful and proper thing to use, but he though the wheels were sometimes too broad. The effect was that the roller was supported at two or three places by projecting stones, and the intermediate parts were not rolled at all, and when the traffic came upon it the soft part gave way. He should not like to see all the hedges removed from the country roads, even to

se the cyclist; they let in the wind, which cyclists not like, but it was very useful in drying the road. planting of trees was carefully attended to in ign countries. When in India he saw a road ch one of the monarchs of the Mogul dynasty le to his palace, 30 miles from Agra, between 200 300 years ago. There were beautiful trees the ole length, and a deep ditch on each side; the ldle of the road was quite hard, but the sides, where cattle travelled, were not taken so much care of. per drainage of the whole bed of the road was one of most important points. He had no doubt the cyclists ld have cinder-paths if they were inclined to pay them, but, at present, he did not think they paid ugh for all the things they wished for. Whether les would ever be taxed, and the taxes applied to making of cinder-paths, he did not know, but re was nothing improper in it. The Cyclists' uring Club had shown its appreciation of this tter in a practical way, by subscribing towards the therance of its objects. Whether they would ever tracks made through London for the use of lists he did not know. He was bold enough to gest once that it was a matter not beneath the tice of the County Council to consider the con-uction of one arterial road through London, so at cyclists might get from the suburbs to the heart the City without running the risks they now did. was a matter pressing on all those in charge of r great towns to procure facilities for working ople to get to more healthy homes outside the owded city, and nothing could do that so satis-torily for all the working-classes as to provide e means by which they could get from their dwel-ngs in the suburbs to the very centre of the town.

Mr. JOSEPH PENNELL said he had just returned om a cycle tour in France of between 1,500 and 000 miles, and it had come home to him that in at country, at any rate, there was a good standard r road-making, though it was not always reached, d it was so good that it had been copied all over urope. It was no use going back to the Romans d holding them up as pattern road-makers. Cæsar ent from Rome to Calais in a very short time, but e did not go in a carriage, but in a litter borne by orses, for which only the hard stone pavement they nployed—of which specimens could be seen out-de Rome now—was fit. There were roads in e Campagna with such ruts that a carriage ould not travel over them at more than two iles an hour; but people managed to get along n horses. Too much was made of the width of the heels; it was not the wheels which spoiled the road, ut the shoes of the horses, and if they could abolish e horse it would do more good than anything else. nd this was coming, not by the cycle, but by the utomobile. One saw all over the continent, and specially in France, traffic being conducted in a mall but increasing way by this means. The work-ng classes could be taken far more cheaply by a motor-bus, and at ten times the speed than they ever could by omnibus or tram. It was a great mistake to use round stones for road-making. He lately went from Toulouse to Bordeaux, over 150 miles, all by the side of the Garonne, and it was about the worst road in the whole of France, because it was entirely repaired with round stones taken from the river. They would never bind, and no matter how good the foundation, such a road would never get into good condition. He had tried several times to get at the information collected by the Department of Ponts et Chaussées, which included a regular school of road engineering, and they had laid down rules as to the gradients and steepness of roads, and on many other points, but they were scattered about in so many publications, that he had not been able to get them all collected together. The French roads were all adapted for military purposes, and on some of them not only was there a strip of grass at the side, but beyond that there was a large embankment through which apertures were made to the gutters, and these, in case of war, could be used as breastworks. The Belgian roads, which once were the worst in Europe, had during the past four or five years been made some of the best. Not only in Brabant, but all over the country, side-paths had been or were being made, and nearly all had a brick foundation. The wheel traffic was kept off by layers of stones on the inside, and by young trees on the outside, planted so close that wheel traffic could not get along. No doubt maintenance was all-important, and on the continent there was continuous care in that respect. Whether it was fair weather or foul the *cantonière* was there all the time, and in heavy rain he worked harder than ever. Ruts were never seen, for they were not allowed. At present the French roads were in a bad condition, for France. In the South they had had rain for three months, and the entire top surface had come off; in the north they had had no rain for some time, and the roads were very dusty. Each man had about three kilometres to look after. He was afraid the good points of the American roads were conspicuous by their absence. He was not aware that the system of convict labour had had any success. Brick roads had been tried, but they soon broke up; they were almost universally used in Holland, and were very good for light traffic if properly constructed and maintained, but the bricks soon broke at the edges, and did not bear the traffic of iron wheels well. The French were now cutting down all the trees which bordered the roads, which from the picturesque point of view was regrettable. They were mostly poplars, planted at regular intervals, which gave patches of shade and sunlight, and these were very injurious to the road. They were, however, planting hedges extensively. In America, tracks of steel rails had been put down for heavy traffic, but they forgot to put a good foundation, and these were not much of a success. Stone tracks were to be found in various places as, for instance, on a long hill near Grantham. The cycle paths in Belgium were paid

for out of the cycle tax. Cycles were taxed everywhere, except in Great Britain, and of course the cyclist demanded his rights. There was an asphalte path by the side of part of Fifth Avenue, New York, which was paved with blocks, and in Paris the Avenue de la Grand Armée, from the Arc de Triomphe to the Bois de Boulogne had two cycle paths, which were paid for out of the five-franc cycle tax. If you wanted good roads, you must have a good system of making, and a good system of repair, for the former without the latter was not of much use.

Mr. DUDLEY WARD (Hon. Sec. Roads Improvement Association) said the employment of tramps in repairing the roads would be the worst thing possible; trained men were required, and that was one of the great difficulties surveyors had to contend with. Hedges, if kept properly cut, did not damage a road so much as trees, and it would be a great mistake to remove them. His association advocated the use of granite as the best possible material; it was the employment of soft stone which made the roads so bad. Where there was much traffic, macadam wore out rapidly, and the proper thing for towns was asphalte; horses got used to it, and could pull a much heavier load upon it than on any softer kind of road. The expense of maintaining it was also less; and even in the City of London it would last 20 years. The smell from wood-pavement mainly arose from want of cleaning. He did not think a hill, if properly drained, required any cross-channels to carry off the surface water, and certainly slanting channels would be dangerous to cyclists. The great difficulty was not that the surveyors were incompetent, but that the Councils under whom they served would not allow sufficient funds or labour to do what was required. They often had letters from surveyors to that effect. They often were not allowed to use granite, because of the greater outlay at first, though it would be cheaper in the end. Stone sets were the cheapest material, but they were fearfully noisy.

Mr. R. JEFFREYS thought the evil complained of was largely a question of administration. Engineers would soon do their part if the necessary money and machinery were provided. What was mainly wanted was some central control. The roads in this country were entirely in the hands of the local authorities; so were the police, education, and the Poor-law, but in each of these cases there was some central authority, which kept them up to the mark; in the case of the highways, it was not so, and he would suggest that in this direction some effort should be made at reform. No new main roads were now being constructed. Notwithstanding the enormous growth of London, and the tremendous increase of traffic, it was several generations since a new main road had been built out of London, and it was the same all over the country. There again the administrative machinery was at fault; there were great difficul[ties] in getting an Act of Parliament for the constructio[n of] a new road. This was a very serious considera[tion] in view of the difficulty of housing the people, and [he] gladly acknowledged the services rendered by [the] Chairman in calling attention in his two addresse[s to] this important question. He thought there ough[t to] be a Parliamentary inquiry into this matter of [the] construction and maintenance of main roads, [and] suggested that those interested should focus th[eir] efforts in that direction, for in no other way could [the] desired reforms be brought about.

Mr. S. BROMHEAD said he quite agreed with [the] last speaker as to the necessity of some central c[on]trol over the main roads. He rose, however, to [call] attention to a material which was highly suitable [for] road-making, which had not been mentioned, v[iz.,] slag from iron furnaces, which he understood made [an] excellent surface dressing, and was not affected [by] wind, like limestone, which gave off immense qu[an]tities of dust. Near Darlington and Redcar th[ere] were millions of tons of this material, land hav[ing] actually to be rented to put it on, and it could eas[ily] be shipped to any part in the country.

Sir H. TRUEMAN WOOD suggested that those w[ho] wanted good roads for any particular purpose shou[ld] concentrate their efforts on the special object in vie[w]. What was wanted at present was good roads [for] cyclists, and if they could get that they might lea[d to] the general improvement of roads for the futu[re]. The reason that we had fairly good roads in Engla[nd] —as we had—was that they were made before the ti[me] of railways, and the reason they had better roads [in] France was that the Freneh were a little later in adop[t]ing railways. The reason they had no roads at all [in] America—comparatively speaking—was because whe[n]ever they wanted to get about they at once thought [of] a railway and not of a road. If there were a d[e]velopment of motor-cars there would be a dema[nd] for roads—the old roads would be improved a[nd] new ones would be made. At present the dema[nd] for new roads was not sufficient to lead to th[eir] construction. They did want improved roads f[or] cyclists, and if they concentrated their efforts on th[at] point there would be some chance of obtaining [it]. The question of paths for cycles by the side of ma[in] roads had been referred to, and if they could g[et] a definite expression of opinion from those qualifie[d] to speak there might be an advantage in i[t]. Such roads were being made in some parts [of] New York and New Jersey. When he was last [in] America, cyclists were in places glad to ride on th[e] railroads, because there were no better tracks, b[ut] now cycle tracks were being laid for which he believe[d] the cycle clubs paid. He did not see why the sam[e] sort of thing should not be done, at any rate, ne[ar] London. The roads leading from London out int[o] the country were, for the most part, abominable yo

to ride a long time before you got far enough to get on a decent road. It was not every one) wanted to ride fifty miles straight on end, nobody liked having to ride for ten or fifteen miles r bad roads before he came to a place where he ived some pleasure from his exertions. If the :.C. and other associations would find out whether y could not put such pressure on the Govern- nt, and the local authorities, as would ble them to get a decent track laid vn by the side of the main roads out of ndon, so as to get away comfortably without riding r wood pavement full of holes, broken macadam, a succession of ruts and sand, they would be doing od work, but he did not think anything would be ned by attacking the general question of the provement of roads. They ought to make up their nds as to the special point they wanted, and con- itrate their efforts upon getting it.

Mr. E. T. Scammell said he had listened with great easure to the paper, though it was not of the aracter he had expected. He expected it would ve been rather a discussion of the best material for e paving of the streets and roads. He was interested hard wood paving, and should have liked to hear r. White's opinion as to whether that material ssessed the advantages claimed for it. He thought, a large extent, the difficulty with regard to some of is wood paving lay first in the class of material nployed; then in the method of laying, and then in e maintenance, or keeping the roads properly eansed and repaired. From what he had heard he ought that hard wood was better than asphalte, d certainly better than soft wood, and he believed was good for the cyclist.

Mr. Moresby White, in reply, said he had to ank the Chairman very cordially for coming and iving the weight of his experience to the discussion, hich it was his main object to evoke. He was glad o hear Sir Henry Wood's suggestion that they should oncentrate their efforts; but he would point out that nless they were prepared to say that cyclists should e taxed it was no use talking about getting a track aid by the sides of the road. It was because they vere not all agreed on that point that they could only ome in their capacity as general ratepayers, and ask or a general improvement of the surface of the oads. He entirely agreed with Sir Henry Wood, and would like to see cycles taxed, and he knew many who were prepared to pay a tax if they could get in return for it a proper track by the side of the high roads. He was pleased with the discussion, and he hoped it would prove the beginning of a movement which would, with the assistance of the Press, spread all over the country, and lead in time to what they desired.

The Chairman then proposed a vote of thanks to Mr. White, which was carried unanimously, and the meeting adjourned.

Obituary.

General Pitt-Rivers, D.C.L., F.R.S.—Lieut.-General Augustus Henry Lane Fox Pitt-Rivers, the distinguished archæologist, died on Friday, the 4th inst., after a long illness, at his seat, Rushmore, near Salisbury. The eldest surviving son of Mr. William Augustus Lane Fox, of Hope-hall, he was born in 1827. He was educated at Sandhurst, and entered the army in 1845. He served on the staff in the Crimea from April to November, 1854, as Deputy-Assistant-Quartermaster-General, taking part in the battle of the Alma. He assumed the name of Pitt-Rivers by Royal license in 1880, when he succeeded to the Rivers estates under the will of his great uncle, the last Lord Rivers. General Pitt-Rivers was a prominent authority on the excavation of prehistoric and Romano-British sites, and his researches are recorded in an important series of anthropological and archæological papers. When only twenty-five years of age he began to collect specimens of weapons, articles of dress, ornaments, &c., which were brought to England from various savage countries, his object being to illustrate the development of specific ideas among savage peoples, and their transmission from one people to another. His matchless collection was exhibited, in 1874 and 1875, at the Bethnal-green Museum. Subsequently he presented it to the University of Oxford, and it is now housed as an annexe to the University Museum. On December 16, 1891, General Pitt-Rivers read a paper before the Society of Arts on "Typological Museums, as exemplified by the Pitt-Rivers Museum at Oxford, and his Provincial Museum at Farnham, Dorset." General Pitt-Rivers filled the offices of President of the Anthropological Institute, and Vice-President of the Society of Antiquaries. He was elected a member of the Society of Arts in 1892.

General Notes.

French Coal Production.—The production of coal, anthracite and lignite, in France for the year 1898, according to the official returns, amounted to 32,356,000 tons, showing an increase of 1,558,000 tons, or 5 per cent. over the preceding year. The production remained stationary for four years (1890-1893), but from 1894 it steadily increased. By reason of the rise in the price of coal the value of the fuel at the pit's mouth rose to £14,500,000 against £13,300,000 in 1897. Two-thirds of the amount of coal extracted was furnished by the important coal beds of the Departments of the Nord and Pas de Calais; 3,913,000 tons by that of the Loire; 2,431,000 tons by those of the Bourgogne and the Nivernais;

1,974,000 tons by the Gard; 1,781,000 tons by the Tarn and the Aveyron; 1,123,000 tons by the Bourbonnais, and 464,000 by the Auvergne. An increased activity reigned in all the regions, except in that of the Bourbonnais, where the coal bed is nearly exhausted. The increase in extraction necessarily brought about an increase in the number of miners. That number was 148,600, or an advance of 5,200 over the preceding year. The wages exceeded £7,000,000. France does not furnish the twentieth part of the coal production of the world, which amounted to 660,000,000 tons for the year 1898.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MAY 16.—"A National Repository for Science and Art." By PROF. FLINDERS PETRIE.

MAY 23.—"Salmon Legislation." By J. WILLIS-BUND.

MAY 30.—"Russia, Persia, and Afghanistan." By A. R. COLQUHOUN.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MAY 17.—The Industrial Development of India." By JERVOISE ATHELSTANE BAINES, C.S.I. The Right Hon. LORD GEORGE HAMILTON M.P., will preside.

MAY 24.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L. The Right Hon. SIR FRANCIS HENRY JEUNE, K.C.B., D.C.L., will preside.

FOREIGN AND COLONIAL SECTION.

Monday afternoon at 4.30 o'clock:—

MAY 28.—"Imperial Telegraphic Communication." By SIR EDWARD SASSOON, Bart., M.P. The Right Hon. SIR HENRY H. FOWLER, G.C.S.I., M.P., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MAY 22.—"The Practice of Lettering." By EDWARD F. STRANGE. SIR WILLIAM ABNEY, K.C.B., F.R.S., will preside.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

Prof. VIVIAN B. LEWES, "The Incandescent Gas Mantle and its Use." Three Lectures.

LECTURE II.—MAY 14.

The Manufacture of the Incandescent Mantle, and the Influence of the Process employed on the Life of the Mantle.—Manufacture by impregnation of vegetable fibres, and by moulding the oxides into thread—The recent advances in mantle manufacture—The theory of the incandescent mantle, and the causes which lead to luminosity.

MEETINGS FOR THE ENSUING WEE

MONDAY, MAY 14...SOCIETY OF ARTS, John-str Adelphi, W.C., 8 p.m. (Cantor Lectures.) P Vivian B. Lewes, "The Incandescent Gas Mar and its Use." (Lecture II.)

Medical, 11, Chandos-street, W., 8½ p.m. Ann General Meeting.

TUESDAY, MAY 15...Statistical (at the HOUSE OF THE SOCI OF ARTS), John-street, Adelphi, W.C., 5 p Annual Address by the Right Hon. Sir H. Fowler, "Municipal Finance and Municipal E terprise."

Royal Institution, Albemarle-street, W., 3 p Dr. Alexander Hill, "Brain Tissue considered the Apparatus of Thought." (Lecture I.)

Pathological, 20, Hanover-square, W., 8½ p. Annual Meeting.

Photographic, 66, Russell-square, W.C., 8 p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, MAY 16...SOCIETY OF ARTS, John-stre Adelphi, W.C., 8 p.m. Prof. Flinders Petr "A National Repository for Science and Art."

Meteorological, 70, Victoria-street, S.W., 4½ p 1. Paper by the late G. J. Symons, "The Wi shire Whirlwind of October 1st, 1899." 2. I Nils Ekholm, "The Variations of the Climate the Geological and Historical Past and th Causes."

Microscopical, 20, Hanover-square, W., 7½ p. 1. Exhibition of Microscopic Pond Life. 2. M E. M. Nelson, "The Lag in Microscopic Vision

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p. Annual Meeting.

Archæological Association, 32, Sackville-street, W 8 p.m.

Mining and Metallurgy, Geological Museu Jermyn-street, S.W., 8 p.m. 1. Address by t President, Mr. C. Algernon Moreing. 2. Mr. Danvers Power, "The Mineral Resources of Ne Caledonia." 3. Mr. W. S. Welton, "Notes Gold and Silver Amalgamation."

THURSDAY, MAY. 17...SOCIETY OF ARTS, 4½ p.m. (Indi Section.) To be held at the Imperial Institut South Kensington. Mr. Jervoise Athelstane Bain "The Industrial Development of India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8½ p.m. Mess W. J. Sell and F. W. Dootson, "Chlorine Deriv tives of Hyridine." VI. "The Orientation of son Aminochloropyridines."

Royal Institution, Albemarle-street, W., 3 p.r Prof. Dewar, "A Century of Chemistry at th Royal Institution." (Lecture IV.)

Electrical Engineers, in the Rooms of the Institutio of Mechanical Engineers, Storey's-gate, S.W 8 p.m. Mr. A. C. Eborall, "Alternating Curre Induction Motors."

Historical, St. Martin's Town-hall, Charing-cros road, W.C., 8½ p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, MAY 18...Royal Institution, Albemarle-street, W 8 p.m. Weekly Meeting, 9 p.m. Professor J. A Ewing, "The Structure of Metals."

Junior Engineers, Westminster Palace-hote S.W., 8 p.m. Messrs. Basil H. Joy and Charl H. Rush "A Short Review of the Motor-ca Industry."

Quekett Microscopical Club, 20, Hanover-squar W.C., 8 p.m.

SATURDAY, MAY 19...Royal Institution, Albemarle-stree W., 3 p.m. Dr. Alfred Hillier, "South Africa Past and Present." (Lecture II.)

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communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

?rofessor Vivian B. Lewes delivered the :ond lecture of his course on "The Incan- scent Gas Mantle and its use," on Monday :ning, 14th inst.

The lectures will be printed in the *Journal* :ing the summer recess.

CONVERSAZIONE.

The Society's *Conversazione* will take place the Natural History Museum, Cromwell- id, S.W. (by permission of the Trustees of : British Museum), on Wednesday Evening, : 20th June, from 9 to 12 p.m.

The following portions of the Museum will open:—On the Ground Floor—the Central ill, British Saloon, and the Fossil and Mam- ilia and Reptilia Galleries; on the First oor—the East and West Corridors.

Each member is entitled to a card for him- f (which will not be transferable), and a rd for a lady. In addition to this, a limited mber of tickets will be sold to members of : Society, or to persons introduced by a :mber, at the price of 5s. each, if purchased fore the date of the *Conversazione*. On it day the price will be raised to 7s. 6d.

These tickets will only be supplied to per- ns presenting members' vouchers (which n be obtained from the Secretary) or a letter introduction from a member.

Members can purchase these additional kets by personal application, or by letter dressed to the Secretary. In all cases of plication by letter a remittance must be closed. Each ticket will admit one person, her lady or gentleman.

Light refreshments (tea, coffee, ices, claret p, &c.) will be supplied.

APPLIED ART SECTION.

Mr. Edward F. Strange will read his paper on "The Practice of Lettering" (which was postponed from April 24th), on Tuesday next, 22nd inst. Mr. Walter Crane will preside.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, May 8, 1900; Henry H. Cunynghame, C.B., in the chair.

The paper read was—

ART METAL WORK.

By Nelson Dawson.

It seems necessary at the outset to make some apology or explanation concerning the title of the subject we are to consider this evening—"art metal work." The phrase is only partly mine, the word "art" being originally placed in inverted commas, which considerably modifies what is not agreeable. We do not hear of art wood work, or art stone work. Let us have art certainly, and metal work by all means, but let each keep to its proper place, and, like good neighbours, they will be all the better friends. There is often in an expression of this kind, unfortunately, a modicum of truth, or a slight indication of a suggestion of a truth, that justifies existence, which makes it so much the more difficult to treat. Added to this is the fact that the objectionable phrase has by custom come to convey a certain idea, which thus becomes difficult to express in any other way, and, willy nilly, one is almost bound to fall back on it.

Art work is not unfrequently "useless" as opposed to useful work, and it is more the latter than the former that I propose to speak about. The aim of all good work, call it art or what we will, is in its relation to humanity—its usefulness or uselessness, and life being short, and our capabilities limited, we have to make a choice, as there is hardly time to consider both sides. Quite frankly I confess that such an object as an ostrich egg in silver gilt setting with a cherub and any amount of German 16th century scrolliners does not interest me at all because its influence on men and women is nil—even when placed in

a glass case in a museum—therefore I do not desire to waste time in talking about it. But a piece of armour or a drinking mug, or a coffer lock, a chalice, or pastoral staff that is beautifully made is of the greatest importance, because it is a necessary part of humanity in a way and bears on human progress.

Since thinking about the matter, I have tried to remember if the ancient Greeks talked about art metal work, or if any author since in writing about the work of their times referred to it in that way, and I do not recall any one instance. Yet, as we know, the Greeks were by no means backward. I have seen modern metal bedsteads (we shall many of us rest in such to-night) with the word Birmingham writ on their brazen foreheads, that beyond doubt would be referred to as "art metal work," and I feel no less sure of having seen (possibly only in imagination) an ancient Greek bedstead of bronze of beautiful shape and workmanship that one would never dream of applying the expression to, it would be sacrilegious; to mention art in connection with it would be to imply that there were those who were not aware of the fact, which would be insufferable. Therefore it may be concluded that the more the word art is used the less art we shall find. "Quod erat demonstrandum."

Yet we may have heart of grace, and be sure it is quite possible that a bedstead may be made even in Birmingham (though this is a hard thing to say), even made of cast iron and brass, and if only the right person with the right mind make it, it shall be good. Birmingham is nothing, the bedstead is nothing, and the metal, rare or common, is nothing, but the mind and hand of the maker is everything. To the old sentence, "There is a time for everything," might be added, "there is a man for everything"—and to have a good result in metal or any other work, it is necessary for the right person to do it under the right conditions.

To begin then, at the very beginning, it occurred to me that I might find something of interest concerning metal work in Dr. Schliemann's interesting account of his excavations in Mykene and Ancient Troy. The work is of great antiquity, for in one place the doctor on opening a tomb makes a complaint that some gold cups must have been taken out by a despoiler—at a time anterior to B.C. 486. But the date of the work itself has been guessed at 1500 or 1000 B.C., which seems a fairly remote time at which to commence. It happens that most of the things he discovered are of gold, the bronze and copper things were either o dised beyond recognition, or had been spoil through the action of the funeral fires. Wi few exceptions these things are of the mo beautiful design and workmanship without a of the accuracy and precision so much look for in these days. But the point is that the gold cups and ornaments thus buried wi their late owner were the things the peop lived with—of everyday use. It was the met work of the moment, designed and made the artists and goldsmiths for quite practic purposes. In speaking of one gold cup, whi was offered as a prize in certain games, contemporary poet spoke of it as being "u touched by fire," by which he made it cle that it was hammered metal, and not cas showing that he thought that this point w the particular one to note.

If we praise the gold work of this very r mote period, of which, naturally, not mu remains, what shall we have left to s about the next period, when metal wo flourished exceedingly, and the Greeks making the objects of everyday use reached point in excellence of craftsmanship and beau of design that has never been since attaine Of this period, which, roughly speaking, w about 400 B.C., and in which bronze was t metal that was almost universally in use, o own British Museum has a very choice colle tion of examples—never much to be i creased, probably, and therefore priceles From the most delicate object to the mo useful; from the hand-mirror of the Gre beauty to the lamp, or the steelyard sca —the firebasket or lampstand, all are in bronz everything is carefully considered in design a execution. To call such work artistic, as w use the word, is inadequate. The spirit th breathes in it is too high for anything short religious fervour—and with the exception of t earliest form of Gothic, it may be doubted even in the history of the Christian Church t human art which thus flourished in the heath era was ever actuated by such high prompting If it were, one can only sadly note that t standard reached was so much lower.

Probably too little is known of the Greek peop who did this work and their times for us t form an opinion as to how it was done, or th conditions that surrounded its production. writer of the time in speaking of the celebrate shield that was made for one of the heroe says that it was of bronze plates beaten o layers of bull's hide—a description that occu more than once, and points to the fact that th

tal-workers were skilled in using the nmer. "Well nailed" is another favourite)ression, and if for nail the word rivet is)stituted, a likely enough change, the iten sheet work is put more forcibly before as opposed to cast work which would not [uire rivetting. Not that these things matter y much, as we are not now seeking to learn secret of the work so much as to consider spirit of it, and, if possible, to become bued with some small portion ourselves.

That religious enthusiasm would satis-:torily account for much is probable ough, but it is remarkable that the same ling and high standard was carried into objects of continual domestic use—and n from a commercial point it is difficult imagine how such objects could have been)duced at a cost that made the average rson able to buy them. With the bronzes of ures, busts, &c., the case was different, cause they were probably bought by the rich ly, as a luxury, and their cost was of less portance. As a matter of interest these ter concern us less, their sculptural qualities tweighing those of the craftsman.

The series of hand-mirrors forms a subject it should be treated alone, and at length, they have been by the archæologists who ve found, in the elaborate figure groups th which they are ornamented, material for iny volumes. But there is an interest beyond it of mythology, and we wander round)king at one and another with admira-n. Like other Greek bronze work it not quite easy to name the exact quality at compels this admiration; only one es not find it in other work. It is t the extraordinary fineness, or the con-ption of subject or the shape, or indeed any e thing; but it is the perfection of the whole the flawlessness, the almost superhuman mpleteness of the work that astounds. One tices that these mirrors are of a similar size area perhaps equal to such a hand-glass as women of our own day use, but the com-rison stops at the point of size. In shape ey are circular, and the reflecting part, iich was of polished metal — now quite rroded away—was protected by a flap or ver. It was on this cover that the wealth of Greek metal-worker's skill was lavished. nerally the decoration was by way of a ure or group of figures beaten up, sometimes the cover itself, sometimes cut out and ned on. The subjects chosen were from ythology, and often such as might be ex-pected to have especial interest for women; as, for instance, Aphrodite and Eros. When not treated in relief, the metal has been made flat, and the design incised in a clear and steady line that would now be the despair of one with a pencil in hand, and which shows a skill with the graver which is undeniably lost to the world. Inlay of silver and gold in the bronze, and possibly other means were used; but principally the design was by means of a graved line, or beaten in relief. Some of these mirrors had elaborate handles, and were formed to stand upright, the round mirror resting on a portion of its edge on the head of a beautiful little female figure; the whole, perhaps, 12 or 14 inches high.

Another class of beautiful objects of this early Greek period are the bronze cistæ or boxes, of which we possess several choice specimens. It is not clear what they were used for, though it would be a domestic purpose probably. They vary in shape and proportion, and are more generally upright, having a lid and feet. The shape may have been followed as offering an even surface for the exhibition of engraved decoration on the sides, whether or no they are so adorned; and the elaborate designs of crowded figures—mythological incidents and so forth—are of much interest. The handles are often in-geniously contrived from the human figure; two nude men wrestling, for instance, finely modelled, give just the shape required to take hold of. To support the box there are, in one case, human feet, but more generally those of lions or animals decoratively treated.

The implements of the bath gave a chance for treatment that the craftsman could not let slip, and, in consequence, we have some fine strigils in the British Museum—one, especially fine, has for handle a female figure of beauti-ful form and modelling. So beautiful, indeed, that one wonders that it could ever have been allowed to run the risk of use by its owner.

The tall lamp-stands must have been a very noticeable feature in the Greek house, and by the care bestowed on their making they were likely enough handed on in the family as the grand-father's clock is nowadays. About 4 feet high, they generally consisted of a delicately fluted column with circular moulded top and base. This column stood on a three-way foot, often consisting of three legs of animals, or shape approximating thereto, all modelled and finished in the most beautiful manner. At the top came a three-way arrangement of branch-ing arms on each of which a lamp might be

hung, and surmounting the whole was not infrequently a bronze figure or group about 6 inches high. One of the best in our British Museum is a charming little bronze of a Greek woman dragging her unwilling son—evidently to bed. Probably, the bringing out of the family lamp was the signal for the younger members to retire.

There is much more that we ought in duty to notice, but we certainly must not omit the very beautiful specimens of Greek armour. Being a fighting nation, armour must have formed a very valuable asset in the property of each man, or of the nation at large. But to think of an army clothed in metal work of such wonderful make as we see in the British Museum is hardly credible. The idea of the armourer seems to have been to make a thin plate of metal that should fit closely and follow the entire contour. It really seems as if even the important point of armour, where safety and protection are everything, the love of sculptural form came first, joy of metal work next, and finally, and more or less casually, they remembered that it was a piece of armour.

Thus, a greave for the leg fitted on and protected the leg between ankle and knee. It was a plate of thin bronze beaten into a shape, not after the manner of mediæval leg pieces, but following the muscular contour of the limb, it protected, not in the imitative way in which we should feel compelled to do it, but choosing, selecting, refining the modelling until it became what only antique Greek modelling could become. So, with the large pieces protecting the front and back of body, each was treated in a sculptural way that is amazing.

Of helmets there are several fine specimens, mostly of that conventional type that Athenè is always represented with—having nose and cheek guards. It seems, on consideration, to be a much more perfect form for its purpose than the Italian mediæval helmet, which was more complicated; and as a form or convention, like so much other Greek work, it impresses one as being the climax; there could be no better thing made on the same lines.

Of weapons of attack and defence there are but few; the blades of the swords, being often of iron, have naturally disappeared into little more than a blurred outline, though that suffices to give one an idea of their general shape.

One other phase of Greek metal work claims attention, and that is the coins, especially of about the 4th to the 2nd century, B.C. The series cover a time from the earliest days, when a little drop of gold, without design, wa used; then a stamp of elementary form wa made, this developing under the care of th sculptors until the coinage of the differen republics, which I imagine every Greek city o importance to have been, reached far abov the highest point that the rest of the wor have ever attained to. As metal work th came distinctly under the head of scul ture; the metal-worker having but litt hand in them, they were modelled in th first instance, and then either moulds mad for casting or dies for stamping. But her as before, all thought of workmanship o authorship is lost in the all-engrossing ap preciation of their extreme beauty.

In the consideration of the ancient Gree metal work and other art generally, one conscious of having before one a phase begi ning and ending—complete in itself—that was a development from elsewhere we kno that it merged into that of other nations lat we know, but neither of these affect the fa of our sense of completeness. It is unnece sary to copy to-day the mythological figu subjects, or the armour, or feminine weari ornaments or anything else, but the wo stands as a great and abiding monument a wonderful people. On the whole one fee that they were a peaceful nation of smoo nature, of great refinement, while they ha been unusually favoured in the qualities their character that made for feeling an poetry and craftmanship. Such a phase w never probably occur in exactly the sam way again, but it is no small thing for met workers to consider how much it may re with them and their work to make or mark a epoch.

In the period following the one alrea glanced at, it is less easy to find materi though not easy to say why. If we referred the other as the Greek period, we may wi equal reason call this the Roman period— the world's history—although in both cas there were other phases of art concurrent wi them. Finding so much to consider in th Greek period, the following one suffers by co trast possibly, or it may be that it requires mo closely looking into. But, at all events, one do not feel able to find much metal work materia There is, however, some really fine Roma silver work—dishes, cups, platters, &c.—th are not so noticeable for their shape, which not much out of the ordinary, as for the wa in which the decoration has been adde In one case a circular dish, having th

ıntre plain and a border of one inch wide, ıs a design of animals embossed and slightly ıtlined with a tool on the face side in a skilıl manner. This is more particularly referred ı, because the method of decoration seems ;pecially suitable to silver, and it has the ldded merit of being only possible to a worker : talent. The freedom of outline, sense of odelling, and the drawing generally, reıiring to be touched in with precision and ıowledge.

The same method of work is to be seen on a .rger scale in the beautiful English sugarowls of the 17th century in the Victoria and lbert Museum.

In other objects in metal the Romans were ınd of inlaying fine silver patterns in bronze, ıd also niello work. But it was in architecture ıat the Romans were chiefly interested—they ere great builders. And architecture, being ıe mother of all the arts, it is not remarkable ıat their enthusiasm was absorbed before it ·ached such a minor art as metal work is ıpposed to be, except in so much as it was ·quired for the purposes of their building, ·namental or otherwise, and it seems likely ıat owing to classical architecture requiring) little assistance from metal work there was uch less done in consequence. What was ɔne was principally in bronze — that metal ɜing more in accord with classical feeling. is difficult to imagine a pair of strap iron nges, such as were so freely used in the later othic period, on the heavily panelled doors ' one of the Roman temples; one can see ıere nothing but bronze hinges, or even less ıan that, a pin of solid bronze at top and ɔttom of the door working in stone sockets.

Thus the metal work would be entirely con:aled and of no account whatever. Inside ıe temples were doubtless bronze tripods ıd other objects which were required for :ligious purposes, but these things hardly ɔpear to have received the thought and care ıat was bestowed on the stone or wood work.

At the end of the time of the Greeks, the omans, being then a young and vigorous eople, overcame them, and carrying off their ɜst artists to Rome, trusted there to found a chool of Art that should continue and rival hat had gone before. We see now that the ethod adopted was fatal to a separate artistic ‹istence. The Romans did, however, secure ı important development, and in a measure ɔmpleted the severe and thoughtful work of ırlier times. In a smaller way perpendiılar work of our own country was to 13th century Gothic what Roman classic was to Greek classic.

The next step, passing quickly from the classical work to the Gothic, was a great leap and one that affects metal work very much. We shall not follow it closely here, though it would be interesting enough. The two phases seem to be so widely opposed that it is not easy to see how the Gothic could follow on the heels of the classic in so short a space of time, a century or two only elapsing between the ending of the one and the commencement of the other. It has always appeared to me, without going deeply into the question, that it was only owing to the interruption of Byzantine art that there is any relation at all, and that otherwise, and without it there would have needed a perfect revolution or casting off of all previous ideas in passing from heathen to Christian art. As it was, the Byzantine merging process allowed of a smoother transition, much of the old state of things being retained and added to the new.

As a people the Byzantines seemed less concerned with architecture and building than the decoration and beautifying of buildings, and thus perhaps is accounted for a revival in what is called, for convenience, the minor arts, and amongst them metal work. In Byzantium was founded that part of the Christian Church known as the Greek Church, which with a gorgeous ritual and pompous ceremonial still exists, and which if no other cause had arisen would have served as a great incentive to the production of metal work. Altar vessels in gold and silver, reliquaries, rich jewels for the priests, and processional crosses formed a field for the metal-worker, and laid the foundation of a class of ecclesiastical work that was in demand until the later Middle Ages. From the early Greek Church of Byzantine times to the Reformation in this country, the Church was one of the great patrons of our craft, and the museums are full of the fine examples that were the result of this encouragement. It is strange that the Greek Church, which has spread comparatively little, has not progressed in such matters, although it still follows the ritual, and has the same love of detail and ornament. Consequently the work is still on strictly primitive lines. However, progress was to be made, and as Byzantine influences came westward, and finding first a home in Italy grew into the beautiful early Gothic form that later, and when more developed was to give such encouragement to metal work. From Byzantium to Italy, omitting

Rome, where classical feeling was too strong for any other form to get much footing, from Italy still westward to France and England the wave of Gothic spread, growing and developing into varying styles until all the then civilised world was affected. From the severe and simple forms of what we find in Italy, it grew into the gorgeous work that was done in France in 12th and 13th centuries, and about the same time in England.

I am not sure how far Gothic architecture in Italy was associated with the enlarged use of forged iron work, but in France and England the two things came at the same time. Notably in the hinges to the church doors, of which those on the great doors of Notre Dame, in Paris, are probably the richest examples in the world. So rich that they suggest an imitation in this hard material of the wealth of ornament that overlaid the walls of the Christian mosques of Byzantium, and that in carved stonework covered the later Roman buildings.

Hinges which grew from the plain knuckle to an iron band clamping together the thick slabs of oak which formed the door, grew very elaborate as time advanced, and when carpentry had improved, and the iron bands were no longer necessary, they were retained as ornaments. At the outset plain—later to become very elaborate and ornamental, finally, in late Gothic times in our country becoming quite plain bands again—hinges themselves offer a very good field of study and are an index of the varying phases of Gothic iron work.

Besides ecclesiastical, other influences were at work on behalf of the metal-workers' craft—there were countries to be won and much fighting to be done. The age of chivalry was at the time of our Norman conquest in the pride of youth and rapidly developing. Up to that time much had been done in the way of fine workmanship in swords and weapons, but that was of small account compared with the sheath armour period that was to follow. At the time of the conquest the principal part of armour was chain mail, either alone or over leather. A surtout from throat to knee of chain, a trusty helmet and shield, was what was chiefly relied on, but this rapidly passed into the form of plate armour, wonderfully shaped and made.

In considering the mediæval armour period, which, as far as the worker in iron is concerned, has offered more scope than any other, it is, perhaps, the Italian work that claims most attention. If the mantle of Greek art fell upon any people it must have been on the early Italians, for until they dropped into evil wa and their imagination ran riot in the time the later renaissance, they led the world matters of refinement of taste and craftsma ship. We admired in the Greek armour t wonderful way in which the armourer had, wh basing his design on the human form, yet co ventionalised it and adapted it to his purpo With the Italian armour the human form w entirely ignored, except as to a few leadi lines. So far from the armourer thinki about the figure, it is obvious that he decid at the outset that he should consider t metal alone, producing from it the b defence to the body, and, that po settled, making it as beautiful as might l The protection against weapons was consist of plates of metal—large when co venient and small and jointed where moveme was wanted, that should cover the whole of t front of the body, and it was the great joy the craftsman to suit his design to this purpo We should remember that the metal work had no nicely rolled sheets of even thickn to work from. He had a lump of ir which had to be first forged flat and th afterwards to be shaped, and if one realis this, the difficulties are increased enormousl

The main thing that strikes one in Itali armour is its beautiful shape. Not only is suit of armour beautiful in itself, but each p considered separately is no less so, a m valuable quality. In the later period the me workers lost sight of this prime necessity, a hastening over the shape without suffici thought, gave all their attention to enrichi the surface. The result is that in all collecti of armour there are some, as in the late hibition at the Burlington Fine Arts Cl there was a helmet, Italian, 16th century (?) e bossed, and enscrolled, and bedizened with g veneer till one's eye ached with looking at it, a all to adorn something that was ill-considered the outset. I have always been much i pressed with the fact that the shape is of more importance than the surface decorati If a thing is of bad shape no amount of ado ment will improve it—the finest suit of cloth will not hide the deformed body.

The English mediæval armourers did not adorn their armour, and often the surf effect of the wrought metal is far finer th the overlaid Italian work. That this sup adornment demanded clever workmanship of course patent—the men who beat up th elaborate figure subjects were doubtless m of considerable artistic training. Those w

ade the pistols with the intricate wheel-ck, and the wonderful rapiers and daggers, ere all men of great appreciation and much :ill; at the same time they were often misled, ıeir enthusiasm and the fashion of the times ›trayed them from the paths of simplicity ıd severity which are ever those of the best ork. The small and select exhibition at ıe Burlington Fine Arts Club was a most ıluable object-lesson to the metal-worker to : sparing with ornament, and to teach him ıat, provided the shape is entirely suited to ıe purpose, and is of beautiful form, nothing rther in the way of ornament is needed. In at exhibition the eye and brain wearied ith the elaborate figure compositions, and ıme to rest on a plain English helmet, absotely devoid of ornament but of fine outline, ith the greatest possible relief and gratifiıtion.

English mediæval armour one should go to ıe Tower to see. There is much to be learnt the way of metal work from it, and as in ıe other case, one wonders at the skill of ıe old craftsmen, a race now dead and comletely passed away. Here we find that utility almost the only consideration, and so far om having to make a criticism similar to the ıse of the Italian work, one feels at times ıat every other quality except utility has been nitted, with a result that there is often a ttle absence of beauty—a lack of perception f line which causes a feeling of disappointıent. In short, without knowing very much bout armour, one can often detect English ork by a slight tendency to clumsiness. The :sson to be learnt is that we should avoid the anger on both hands and steer a middle ɔurse. One of William Blake's original roverbs was "Enough or too much," a selfvident truth that affords much scope for :flection.

It seems from the metal-worker's point of ıew that the end of the mediæval period oncludes the important phases of metal work ıat occurred in the world's history, but in our wn country there were one or two lesser hases that are of no little interest. One of ıese was the English silver work of the 17th nd 18th centuries, which now we are able to ›ok back on it as a whole we can see was haracteristic and individual. While speaking f the Roman silver work I mentioned an nglish silver sugar basin in the Victoria and lbert Museum—there are one or two there f varying design and workmanship. Beaten p by hammer they have a not elaborate shape—with lid and cast handles. The plain surface of the sides is broken up admirably in one case by a design of poppies—rendered in a way that is entirely suitable to the metal. The date is about 1650. There is much other silver work, the earlier as a rule the plainer it is, and therefore the more to be admired. In the middle of the 18th century we were, like other nations, under the pseudo-classic influence, and the fashion ranged between the delicate modellings of the Adams to the coarse acanthus leaves and fluting of the worst time of the Georges. Here, again, is an example of how fashion or phase operates on an art or craft. In the more delicate mouldings used at the Adams time, casting was the only way to reproduce them—they were cast solid and then minutely chased. On the other hand, the bold acanthus leaves were better rendered by bumping up in sheet from the back and then finishing from the front; and these two branches of metal work, although one would hardly think it, would require quite different workmen, the one branch of work being so opposed to the other. In speaking of English silver, one cannot pass by the delightful tea and coffee sets that were so much in fashion at the latter part of the last century. These were known as boat-shaped, were of simple form, and rarely ornamented with anything more than bands of lines. They were very English in feeling, and I much doubt if the shapes were not confined to our country; there is, at all events, something in their bearing that makes them dear to English people, and they are admirable pieces of metal work.

There was besides this silver work in our country during the last two centuries a very interesting and creditable phase of forged iron-work which resulted in many objects of domestic use—trivets, fire-dogs and backs, fire-irons, &c.—and on a larger scale the railings in front of houses and surrounding gardens, of which we shall see some photographs on the screen.

It must not be thought that it was in England only that such work was going on—this is referred to as being characteristic and worthy of note. Spain was rich in metal-workers also, and some very fine and costly ironwork was produced there. In France, too, there was much metal work being done, and in each case it is marked with the character of its time and country.

One ought not to omit Germany where smithing and much other metal work flourished, although, as a rule, German

metal work lacks that simplicity that one admires in other work.

Now, as to our own time, what shall we say about it? We have been critical enough respecting past times, and people, and the mote in their eye, but what about our own metal work, and our own eye? The things we surround ourselves in our homes with, the grates and fenders, and fittings on doors, and gas chandeliers, and electric light fittings, our knives, forks, and spoons—will they ever be found in a museum, or will they be referred to lovingly before learned societies, as is now the case in regard to the ancient works. The jewellery we wear, and which we see in the goldsmiths' shops—our Crown jewels and regalia—the orders in gold and enamel that our nobles wear on State occasions—what can one say about all these things? I should like to be as kind to ourselves as possible, but I feel unable to speak in their favour.

And yet we might have good metal work; there are our iron bedsteads, and a hundred other objects that are open to good treatment, without being made too costly. The list would be a long one if we went through everything that we have around us that the metal-worker might improve. The truth is no list should be needed. The corrective should not be in the shape of by-laws and rules so much as a clean and wholesome desire springing up in the minds of the people at large for something better. There have been some signs of the grey before dawn latterly, and the keener appreciation of old furniture, for instance, is a sign of the right state of mind. This in time should become an appreciation of good work generally, and I should like to think of metal work in particular.

As I say, it would be idle to specify what things might be improved with advantage in metal work, but it is not unreasonable to think that there may be a time to come when the hand and brain of the individual craftsman shall not be of less concern than a good gas-engine, and when people will value work with personal thought and care in it.

A line in one of the Psalms struck me with much force recently—it seemed to be so very apposite—whatever meaning the writer meant originally to attach to it—

"The work of our hands—establish Thou it."

DISCUSSION.

The CHAIRMAN said there could be no doubt after what they had seen, that English taste was exceedingly bad, and foreign taste still worse, in mode work. It was a thing which they ought to thoroughly ashamed of. The truth was Governme had made great efforts to teach artists, but the fau had been that no pains had been taken to educate t public. Everyone went into a shop with the fir conviction that they knew all about art as they d about politics, without having studied either. the formation of artistic taste two qualities oug to be exhibited, neither of which the public seem to possess. In the first place they ought to be timi for they could not judge of a work of art well unle they gave a great deal of time to study the be examples. The second great fault, which seemed contradictory one, was a want of honesty. Frequent they were ashamed to say they liked a thing wh others said it was hideous. At all events, we oug not to want for good artistic taste, as great effor had been made to put before the world good thing Yet every year a great amount was spent on articl which in 100 years would not exist at all. must be remembered that past ages had the bad things too, and it was not fair to compa the survivals of bygone ages with the averag of the ordinary work of to-day. Papers lil the present would do a great deal to improve t taste for art, and make people more discriminating the articles they purchased or approved. He thoug he was correct in saying that with regard to met work, glass work, or enamelling, there was not o secret of the ancients that we did not now posses and our colours were more brilliant, and the app ratus, &c., more perfect than those of the Greek who would have revelled in the splendid means no at the command of artists. The cast iron which w do not know how to use artistically, Greeks wou have moulded magnificently, and with our wroug iron and steel, and aluminum, they would have pr duced marvels. But we are like intellectural beggar as it were, in the midst of wealth. It would be study for future ages how they should learn to pr duce something different from mechanical repetitio of old art. In conclusion, he had much pleasure i proposing a hearty vote of thanks to Mr. Dawso for his interesting paper.

The vote was carried unanimously.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 16, 1900; Sir CHARLE MALCOLM KENNEDY, K.C.M.G., C.B., Vice President of the Society, in the chair.

The following candidates were proposed fo election as members of the Society:—

Bull, Henry, 1, Queen's-gate-terrace, S.W.

Dwarkadas, Naranjee, 53, Esplanade-road, For Bombay, India.

ngo, A., Messrs. Foscolo, Mango and Co., :onstantinople, Turkey.
ldleton, Reginald Empson, 17, Victoria-street, Westminster, S.W.
rris, Captain R., 3rd Bengal Cavalry, Hissar, ndia.
o, Viskvanatt Patankar Madhava, C.I.E., Bangaore, India.
stamji, C., Rutlam, Central India.
ieeler, Oswald, 76, Heathwood-gardens, Old :harlton, S.E.

The following candidates were balloted for d duly elected members of the Society :—

own, John McLeavy, C.M.G., Seoul, Korea.
mpbell, P. B., Anuradhapura, Ceylon.
arlier, Andrew C. J., Sussex-house, Hill-street, Glasgow.
oper, Henry, Messrs. Vickers, Sons, and Maxim, Limited, Sheffield.
wkins, Clinton Edward, Brooks's Club, St. James's-street, S.W.
ssanaike, Edwin Seneviratne, Technical College, Colombo, Ceylon.
stetner, D., Norselands, 124, Highbury New-park, N.
rbold, Henry, 20, Goldsmith's-row, Hackney-road, E.
iffiths, John, Binton - cottage, near Farnham, Surrey.
osvenor, George William, Broome-house, Stourbridge, and Worcester-cross, Kidderminster.
ire, Lancelot, C.I.E., Bankipore, E.I. Railway, India.
irris, Jonathan James, Grey Abbey, Cockermouth.
ighes of Kinmel, Hugh Robert, Kinmel-park, Abergele.
er, Robert Wilson, 72, Upper Parliament-street, Liverpool.
indersley, M. F., Cavalry Club, Piccadilly, W.
slie, William, 2, Chowringhee - road, Calcutta, India.
adhowlal, Chinoobhai, Ahmedabad, near Bombay, India.
ichell, Brigadier - General St. John Fancourt, Bareilly, India.
uir-Mackenzie, the Hon. John William Pitt, Royal Bombay Yacht Club, Bombay, India.
errins, Charles William Dyson, J.P., Davenham, Malvern.
iillott, George Henry, M.A., 13, Promenade, Cheltenham.
gott, John Robert Wilson, Paramaribo, Surinam, and Highfield, Bath-road, Reading.
eitmeyer, Robert, Shortlands, Kent.
utnagur, Sorabji Muncherji, 27, Meadow-street, Bombay, India.
ater, John Sanders, B.A., B.L., Malabar-hill, Bombay, India.
'acha, Dinshaw Edulji, 84, Hornby-road, Bombay, India.
Weil, Walter Horace, Stock Exchange, E.C.
Woollen, Thomas Henry, Arrol Works, Long Acre, Aston, Birmingham.

The paper read was—

A NATIONAL REPOSITORY FOR SCIENCE AND ART.

By Prof. Flinders Petrie.

At the end of a century which has so rapidly and greatly changed our very conceptions of the nature of knowledge, and our standpoint for seeing both man and his world, it is well to loosen our old ideas somewhat, and look at things with fresh eyes, so as not to be in bondage to conditions that have already passed away. No one would now think of writing a scientific or historical book on the lines of treatises of 1800 or even 1850. And if that be true of the formal presentation of our new knowledge, how much more is it true of the nature of the materials and evidence on which our books are built. It is this subject—of the preservation for study in the future of all the evidences and material on which our knowledge is founded, and on which it has yet to be advanced—that I wish to consider now. It is a wide matter and has never been viewed afresh as a whole since the expansion of the sciences of man and nature. Moreover it is a very urgent question.

Science—all knowledge—lies in two opposite categories as regards its materials. The experimental sciences can have their proofs repeated as often as desired; chemistry, physics, physiology, have nothing to fear from the destruction of any materials. But the evidential sciences rest on a basis which may entirely vanish if not carefully preserved. Anthropology may never record whole races that become extinct; archæology may lose all that remains to explain and link together the history of man; zoology may mourn over species that have vanished; geology may see the proofs of climatic condition expunged by modern changes. For all knowledge that hangs on irreplaceable evidence, it is our duty to the future to preserve the proofs which otherwise will never be seen again.

Let us look at the present needs, and take first those which I know most personally. Where is our possibility of preserving all the new world of prehistoric man that has opened before us in the last thirty years? There is scarcely a single burial preserved intact in any museum; though you may see long rows of objects from such tombs, divorced from all else

that belonged to them. We are yet in the days of ignorant looting as regards the keeping of the evidences. Italy has succeeded in keeping a few dozen entire burials, but in England not one has been kept out of each thousand destroyed; nor are there any serious number of groups preserved, as they have been found together. Tomb groups are hated by the museum curator because there is always something ugly, something too big, something untidy, in the group; and so science may go hang, but the museum must look nice and contain objects all duly attractive to the ignorant. Yet the real advance in the science of man is utterly dependent on these groups of objects found together. Until we have a thousand or two from any country recorded, and to be studied freely, it is impossible to unravel its early history. Now turn to foreign lands. We have nothing yet but stray examples of the prehistoric ages of other countries. In Egypt alone the prehistoric pottery extends to 900 varieties; when offered to the British Museum I was asked to send as few as possible. The largest set, though far from complete, went to the Ashmolean Museum, and space was only made for it by stacking one tall case on the top of another, and so skying the collection up to fifteen or twenty feet. When any fine complete tomb is found, any large series, any great objects, we have to send them to America because there is no room in England.

Yet Egypt is but one land. There is all Europe, the riches of prehistoric France, Scandinavia, Italy, Greece, Hungary, Spain, every one teeming with things that we covet and might have. There is the yet untouched East, the cities and the countries of Asia Minor, of the Hittite land, of Syria, the vast civilisations of Mesopotamia, all unopened, hundreds of great mounds of cities full of history, all yet to come upon us with a deluge of facts and materials whenever they are enquired of. Further, there is India, of which we have but a few samples, Cambodia, China, Japan, Central Asia, all ancient and grand civilisations, of which we have scarcely a fragment, and all waiting for the spade in the coming century. And beyond there is the whole continent of America, scarcely outlined in our museums. Yet to get ten square yards more in English museums is a problem. Within a century more our present collections will seem as puny as those with which we began the century seem now to us.

Nor when we turn to well-known classical times is the prospect much less serious. Th bulk of the Greek and Latin inscriptions that w possess is stored in cellars of the British Museu in the worst of lights. Nothing of the mo favoured ages is preserved unless it is of artist beauty. We have no space for models of buil ings. We have not a single Greek tomb pr served. Yet in Philadelphia a series is begu of tombs of all ages and lands preserved entir When the earliest Greek tools were offered t the British Museum they were declined a being too ugly; now they have been lost beyon recall. There is practically nothing known an preserved about the greatest civilisations of th past, unless it is kept for its beauty or value.

And the subject of casts is a national scanda Of all the priceless treasures of Italy an Greece, the sculptures which are needful f study, for training the taste, and for teachin the history, we have but a scanty gleaning o casts. A few years ago these might be see crowded together, so that one could not se the figures for the plaster, but yet of som value to those who would take trouble. Aft that, they were banished to an impossible situa tion where no detail could be seen. We hav nothing in London at present to represent th larger world of ancient art which exists in oth countries. A real and worthy museum of cast should be much larger than the collections o originals that we have.

And when we come to the last fifteen hundre years the prospect is far worse. Of our ow architecture there is no collection, except small one belonging to the Institute of Britis Architects; scattered piles of mouldings with out a history may be seen in local museums but there is no home for any remains of th innumerable buildings that have been wipe away by modern changes. To trust architec ture to our standing buildings, is to leave it t be all certainly falsified by the restorer soon or later. To house good examples from th many buildings that are destroyed in Englan and abroad, by the speculative builder or th commission-hunting architect, is our first dut toward the works of our forefathers. Yet I d not know any place where a single doorway o window could be set up and preserved. Suc are, however, the most recognised and popula remains of the Middle Ages. What about th domestic life? Here and there are a few stra pieces of furniture, tools, pottery or dress Some that can be claimed as artistic find safet in South Kensington; small and neat object may rest in the British Museum. But nowher can an old English room of each century b

:en put in order; nowhere can a dated set of ie pottery be seen; nowhere are there models ' houses to show their form and development. ome large furniture and coaches are stored onourably at South Kensington, rather dark nd very cramped; but apart from a series ich things border on mere curiosities, devoid real instruction, and the prospect of half a ozen more wardrobes and coaches would adden the authorities.

Now let us turn to ethnology. Every year ie tribes of our Empire are dwindling, becom- g extinct, or merging with their rulers. Our vilisation has wiped out races at a greater ite in this century than in any other of the orld's history. Yet there is no place where ie remains of these peoples and of their civili- itions can be preserved. The British Museum overcrowded with only a small fraction of hat should be kept. If any worthy collection skulls and skeletons of a race is obtained, can at present be stored, packed in boxes, in ellars, at Cambridge; but there is no place here a few hundred skeletons can at once be aced and kept accessible for study. Yet 'ery year a few hundred come in from excava- ons alone, to say nothing of what ought to be otained from our Colonies.

A zealous administrator in some distant gion may wish to preserve the fast-vanishing irroundings of a race, their house-life, hunt- g, and conveyance; occasionally we have an ficial who thus rises to the scientific duties of s position. Yet if he attempted to send such ings home he would not find a single place which to put them. What we ought to have, efore it is too late, is an example of the velling, the daily work and utensils, the othing, the boats or saddles, and the products each distinct tribe whom we shall extinguish modify before the next century is out. To ouse and protect such things might cost £3 £4 a year for each series.

And in other subjects, as zoology and eology, it is certain that there is a great nount of material requisite for researches hich yet cannot be housed in the expensive ondon museums. The study of variations is ily just beginning, and is seen to be the key the great questions of species. Yet series hundreds or thousands of the same object, owever needful, however irreplaceable, cannot kept in existing museums; even duplicates large specimens are a bulky luxury in ondon. And the larger geological specimens e scarcely ever preserved. A few erratic ocks lie out in the weather and smoke of London or Manchester, but that is all. The bulky specimens of such blocks, of ice mark- ings, of junctions of strata, which are of great importance in metamorphism, of deep borings, which give most costly records of underlying strata, all these are hopelessly lost at present or kept only in hand-specimens which can never represent the whole facts. When thousands of pounds have been spent on a boring, we grudge two or three pounds a year to keep the result of it complete for future study. In every science minute examination of differ- ences is now the method for further advance, and such work absolutely needs large amounts of material.

Most of the remains of man which we have been noticing are irreplaceable; when once found they must be preserved, or they are lost for ever. We are the trustees for all future ages. And for us to suppose that all these remains of all the past civilisations of the whole world are to be compressed into one square furlong at Bloomsbury, is manifestly absurd.

At the beginning of this century the British Museum was begun in an airy suburb, much what Highgate or Ealing is now. At the end of this century it is in the midst of square miles of houses, with land of high value around it. It is hopeless to suppose that, with all the con- ditions changed against it, such a site can be fit for the whole of the expansion of historical material on a scale which was not dreamed of when it was founded. How can it possibly be hoped that a museum which sufficed for 1850, when the science of excavating was not begun, can hold the abundance of 1950? Entirely new conceptions have grown up, and we might as well hope to make the old "Universal History" contain all that we know of the past, or Buffon our text-book for zoology, as compel a museum of that past age to serve the needs of the present.

To say that nothing shall be preserved that is not worth many pounds for each square foot, is to destroy all hopes of progress. To cling to the old conception of a royal treasury where valuables are preserved, where everything must be costly and noble, is to ignore all our present position. Yet we virtually do so, by saying "The price of preservation is £5 or £10 per square foot; perish all that is not worth so much."

What then must be our new store-house of knowledge for the future? What are the changed conditions and requirements which have to be met? First we require two very different classes of buildings and of conser-

vation. For valuable objects of which no possible deterioration must be permitted, and which must be safeguarded from risks of theft, such buildings as our present museums are admirable. But for rougher objects, and things of small individual value, we need a much less costly and elaborate system. To pay £5 a piece for the standing room for rough pottery is absurd, when it can be kept just as usefully at 5s. a piece. A fine site in a city, a noble building, costly glass cases, are all quite inappropriate to the greater part of the material which has to be kept and studied. We must then cast aside all the traditional system of present museums, and look plainly at what are the necessities and how they are to be met.

The first necessity is that space shall cost a minimum, compatible with safety. The requisite space being thus cheaper than the labour, the shifting and re-arranging of objects must be avoided as much as possible; and building must be capable of interminable expansion at any point, so as to allow of incorporating large collections without moving everything else to agree. The system to which these necessities point is that of long galleries, far apart, against which much larger annexes can be attached at any point. Thus we reach what we may call the gridiron pattern, of galleries widely spaced apart, to allow of free growth laterally. And all this must of course be placed outside of London rents.

At this point we are brought up by various fallacies which spring from the fossilised ideas that people have about museums. One person says the building must be "architectural;" that is to say because we spend a pound for science we must make it five in order to decorate some public site. As our present Director of the Natural History Museum has said, we must begin by hanging the "eminent architect." If the public like to pay for public decoration let them do so, but do not call a penny of that money expenditure for science. The plainest, simplest barn may be made inoffensive, by covering it with creepers and screening it with trees. Nature will give you the most beautiful aspect to a museum for nothing. And by simply growing plantations between the galleries, we shall protect from weather, make the outside beautiful, and bring in rent from the spare land. Another objector will say that everything must be placed in good glass cases, regardless of the fact that the things are not all worth it. There must be some class, and a
very large class, of things that are worth kee
ing but not worth expensive cases. The simp
system of boxes or shelves covered in with lar
sheets of glass at 3d. a foot is quite go
enough for rough objects. And many thin
do not need even that in clean country a
filtered free of dust on its admission to t
building. Yet a third person will from o
habit long for an upper storey, that curse of
good lighting, which is needed on an expe
sive site, but which is quite absurd on che
land. Next we are told of the precautio
against thieves, in a place where there wou
be no valuables, and where the small thin
would be locked up and the large things t
heavy to move. Fire insurance is the ne
objection raised against a totally uninflam
mable building without any wood. Yet aga
the solemnity of registering every objec
with drawings and full description, is sa
to need a costly staff. But we have learn
to register the stars by the thousand phot
graphically instead of registering each sep
rately, and so we must do for the conten
of our store-house. A photographic regist
of groups could be done by cheap artis
labour, and very rapidly kept up. All of the
objections are so many fossil remains of a
entirely different set of conditions to those wi
which we now have to deal. Some say let
leave everything to local care; let loc
museums keep everything as found. Well, l
us then carry that further, and leave thin
safely buried instead. The local museum h
its own uses for elementary instruction; but n
student could possibly race over the whole wor
to find the examples of any subject he neede
The very aim of a museum is to gather thin
together for comparative study. Moreov
the local museum is a snare. In an Engli
city with a Roman ancestry the whole
the local antiquities were lately stacked in
cellar in order to grab the museum for
technical school, and nothing can now be see
Perhaps no one will ever see them again.

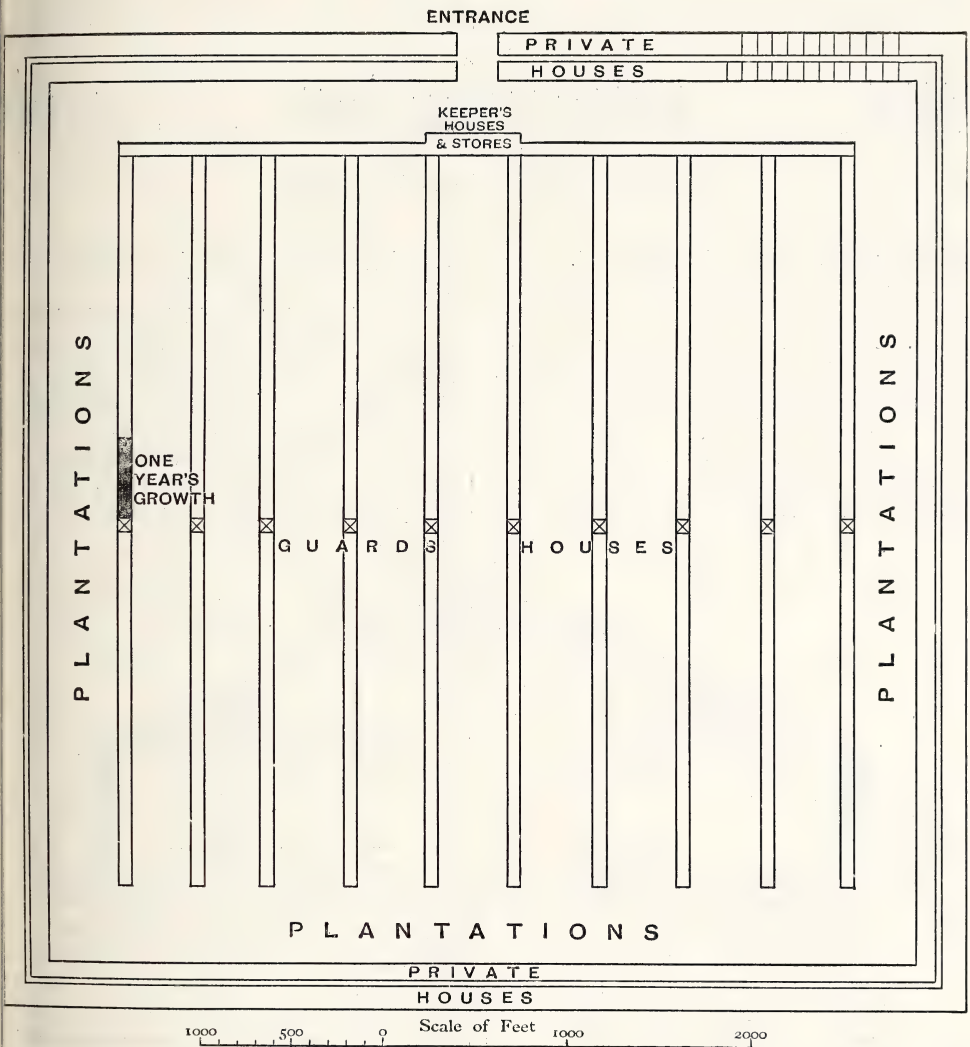
All these fallacies are mentioned to sho
how much we need to clear away the ideas of
past order of things, before we start afresh.

Let us suppose then a square mile of pi
wood somewhere within an hour's train fro
London. This distance would include su
places as Witham, Hitchin, Leighton, and Rea
ing; or the half-hour radius would reach Ha
field, Watford, Slough, and Aldershot. With
that nearer area there is excellent dry sar
country to be had for £50 an acre. Even d
chalk land at £10 an acre can be had with

ı hour of London; but there would be no ason to try to economise on £50 an acre in ew of the other expenses. It might be worth ıile to pay more. For simplicity I have sumed that a square area would be used, ıt probably some more irregular form would actually obtained.

Now it is obvious that if we have such a betterment which will result, and use for the benefit of the collections the value which is created by their presence. This might be done by allotting a ring of road around the whole ground, with building sites on each side of the roads, and buying also the land which leads up to the enclosure. Thus the land improvement would all go to help the museum

Fig. 1.

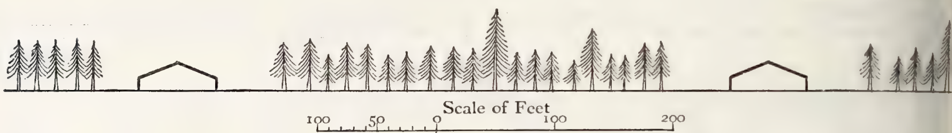


entre for study anywhere near London it will oon become a favourite residence for scientific eople who do not need to live inside London, it be placed in a healthy and pleasant ountry. It will, in a generation or so, be to reater London what South Kensington was to he Lesser London of fifty years ago. Therere, it is an important matter to capture the by providing £2,000 or £3,000 a-year of ground-rents. This village thus created by the museum must have some name, and we cannot be always using several long words for the museum. It might very appropriately be called, after the founder of the British Museum, the village of Sloane, a name familiar to every Londoner. The Sloane Galleries would soon

outgrow any confusion with the little collection of Sir John Soane.

On the general plan of the site we see what it would grow to in a century or so. At first it would be left covered with plantations, and clearances would only be gradually made as the growth of galleries and houses required. The amount proposed as annual increase is shown as a black block. Now, coming to a larger scale, we see the proportion which the galleries would bear to the woodland. The trees would protect the buildings from heavy weather, arrest dust, and form a pleasant screen. The land would also pay by wood growing until it was actually used for building.

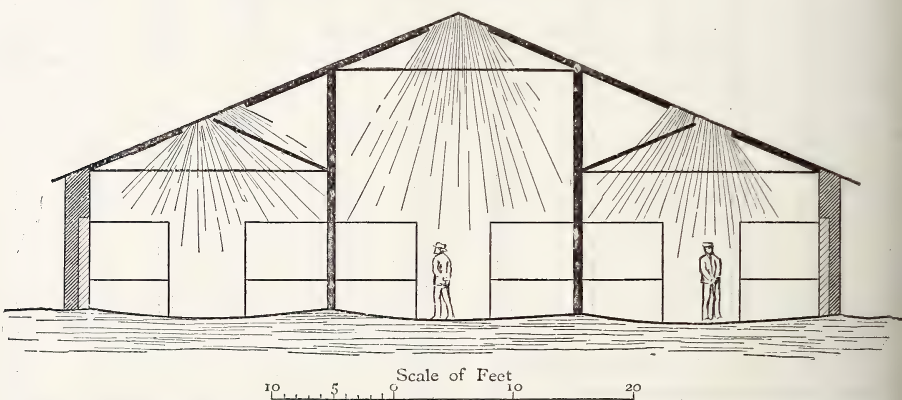
Fig. 2.



Proportion of Galleries and Plantations.

Coming to more detail, the form of the galleries which would seem to pay best for general collections would be a width of about 54 ft. divided into three spaces. The roof would be of iron and slate, carried by iron pillars. The floor of cement. Thus no part of it could burn. The cost of such a building would be about £200 per bay of 16 ft. length. The lighting would be by skylight, a quarter of the whole roof area, giving from 18° to 36° of clear sky in different parts. Thus the whole of the glass could be over the open gangways; and this would prevent glaring reflection from table cases, and save any leakage of the roof from falling on cases. The side walls should have a wide archway in each length of 16 ft., bloc[k]
with thinner wall. Thus extension, latera[l],
could be added to any bay which required,
without any shift of the collections. [Th]e
heights of table and upright cases are roug[hly]
shown, to give an idea of the space; but ma[ny]
parts would, of course, contain larger objec[ts].
The dwellings for the staff of the muse[um]
would be at intervals across the galleri[es],
dividing up too long a perspective, a[nd]
rendering custody of the contents mo[re]
certain.

Fig. 3.



Section of Repository.

The fittings that would be required wo[uld]
necessarily differ much from those of pres[ent]
museums; in them thieves and dust have [to]
be avoided. In the Sloane galleries th[ere]
would be nothing of intrinsic value, and th[ere]
would be no dust in a place only visited [for]
study and supplied with filtered air. To co[m-]
pletely cover the exhibiting area with gla[ss]
would only cost a fifth of the amount whi[ch]
I have allowed for fittings, and therefo[re]
everything could be put under glass whi[ch]
might be disturbed by handling, or whi[ch]
required a dry air. Damp should be prevent[ed]
by a free use of trays of quicklime in all t[he]
cases. Large sheets of glass laid over box[es]
with a felt edge would serve all the needf[ul]
purposes of glass cases. Where great[er]
security is needed, lock-up glass cases can

ıade on a large scale at 1s. 6d. a cubic foot. o far as possible, shelving and supports hould be made of slate, metal, and brick, so s to be uninflammable. The registration I ave already alluded to as being best done hotographically. The objects, and all in- ɔrmation about them as to source, donor, &c., hould be photographed on a fixed scale, in a pecial camera house, at the time they arrive. 'he cost of plates and labour to photograph ouble the annual exhibiting area would be nder £50 a year.

The delicate question of staff and constitu- on have to be met. The Sloane would be ssentially a store-house, at least to begin 'ith; it would not need specialists, and any ıformation wanted about rare objects could e given by the staff of existing museums from me to time. An active keeper of good dministrative and mechanical abilities would e needed; a staff of assistants under him; nd a small body of porters and labourers. 'here would be but little clerical work, and ery seldom the tedious business of shifting revious acquisitions. Once in a generation general re-sorting of all the material of one ubject might be done, but this would be a ıre item. The essential business would be to rrange the contents of a gallery at the rate of ne 16-foot bay every fortnight. Thirty men ught to be able to do that easily in the time.

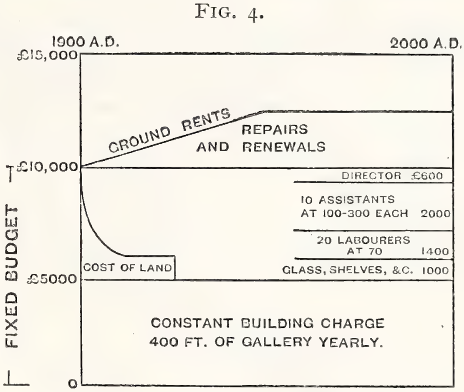
The control should, of course, be exercised y a body of trustees; and if such were ominated by the large museums and principal ocieties all interests would be fairly repre- ented.

And how is this space to be filled? This is the lank difficulty to some minds. To anyone 'ho has had practically to form collections at rst hand from Nature or from man's remains, ıere cannot be a moment's hesitation. The urator, who sits at home and waits for dealers nd sales to bring things to his door, can have ut a faint idea of the enormous mass of ıaterial which he never sees, because it will ot "pay" commercially to bring it. More- ver, it is well known that any museum that ıakes space soon gets it filled with gifts. very museum that has expanded—like the shmolean—in a far-seeing manner for future equirements, finds that it has not seen nearly ır enough, and that the free supply of worthy resents that pour in very soon fill its spare pace. Moreover, at first the Sloane would be ıe clearing ground for freeing the existing ıuseums from everything of small value and ttractiveness. For several years of building it might well be filled with such overflow. That the British Museum should thus devolve the care of its contents of lesser value is at last a necessity that is to be met in the library by powers of very free-handed disposal to local centres, or even destruction. Such powers in other departments are therefore to be expected sooner or later. As yet nothing can legally leave the museum, but useless lumber can be interred in the grounds.

The vast prospect of results from the various lands whose ancient civilisations are still un- touched, and from our present Empire, whenever we study its races, will tax even the storage which is here proposed. In all cases it must be remembered that the curse of existing museums has been that they have had to cut down most collections in a Procrustean manner to fit the square yards allowed by the architect. But the first condition of a suitable building is that it shall be well a-head of what is required of it; and that classification shall not be hampered by always having to fill the last available corner. To build a few years ahead of the needs is one of the first conditions of economy, where the staff costs as much as the building.

So far I have only alluded to the cost of various items; but we now have to face the finance. As a reasonable estimate I have to propose a fixed budget of £10,000 a year.

FIG. 4.



COST OF NATIONAL REPOSITORY.

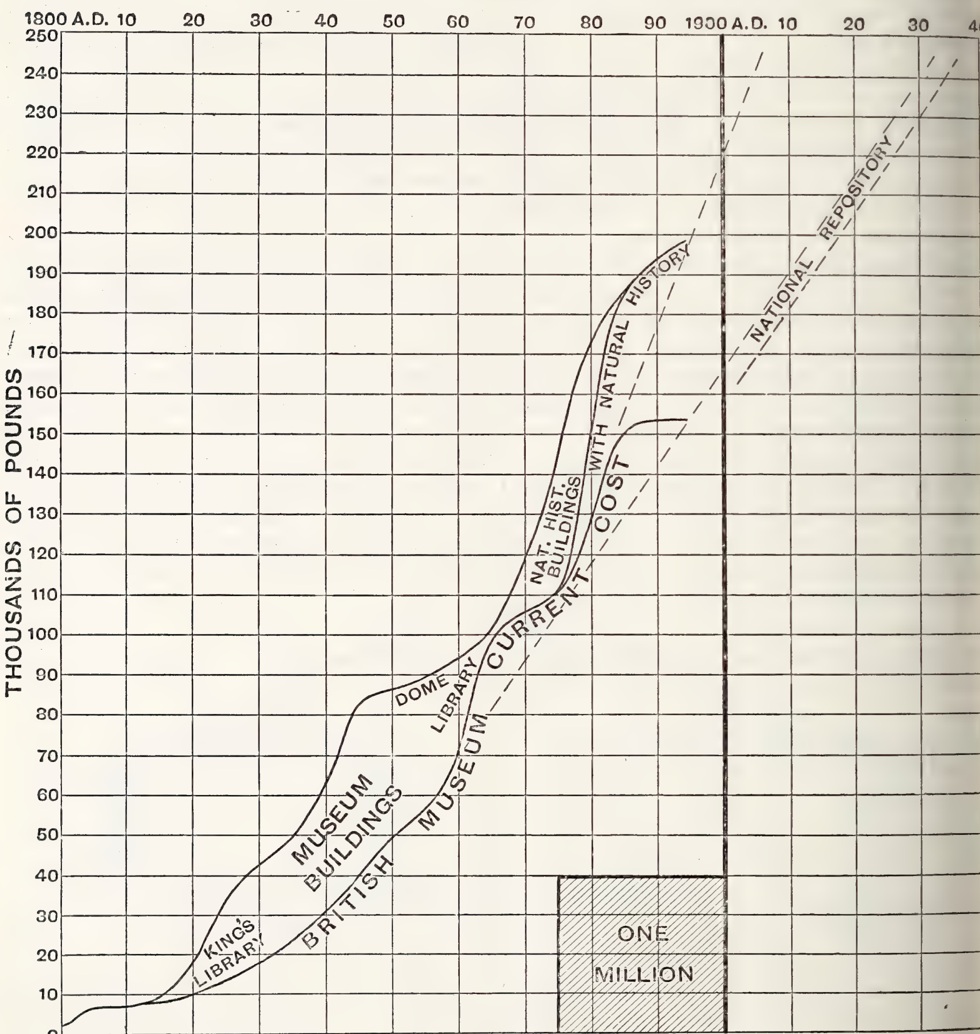
This would include all land, buildings, repairs, and staff enough to deal with the flow of acquisitions. How this amount should be distributed is shown in the diagram. A regular expenditure of £5,000 a year would provide 400 feet of gallery, or fill the whole skeleton plan of eight miles of galleries during the century. This would leave sufficient inter- mediate space on the land for several centuries

of expansion at the same rate. To keep the rate of building constant, would be much the most economical system; but of course the position of building each year would be determined by the needs of different departments. With a fixed type and system, every part would be alike and interchangeable, and could therefore be made at the lowest cost.

suitability of the site rather than its cheapness.

Then for the staff, we might provide for keeper at £600, 10 assistants at £100 to £30 each, and 20 labourers at £70 each. Their work would be to arrange between one and two square feet per man per day; an easy allowance, even with the preliminaries of

FIG. 5.



COST OF THE BRITISH MUSEUM (DECENNIAL AVERAGE).

The value of land at £50 an acre would be best met by an initial charge of £4,000 a year for interest and amortisation, rapidly diminishing as the staff increased, and becoming extinct in about a quarter of a century. It bears so small a total proportion (as shewn by its area in the diagram) to the staff and building charges that it would be best to consider the

shelving, &c., to be dealt with. As I have said, £200 will cover the whole exhibiting area with glass, which would be more than needful.

The item of repairs and renewals would of course be serious; but this would not begin for several years; and it is not too sanguine, I think, to look to the rise of ground-rents to

eet that, without an increase in the budget. efore the century of building was done the nd would certainly be all taken up, and be ·inging in £2,000 or £3,000 a year as ground-:nt.

It does not seem, therefore, that more than 10,000 a year would be required, apart from ny money wasted in useless show, which must ot be set down as scientific expenditure. hat may be said to be a great deal of money, nd some people say that the Treasury would ever find it. Let us see what the Treasury oes.

In the last diagram we have the expenditure n the building and staff of the British Museum uring the century; excluding the charges for aintenance of the buildings, about £10,000 a ear, and excluding all votes for purchases of ollections and for excavations. It will be seen at £1,000,000 is a modest looking square in e corner. The area below the curve shews e total expenditure in the century. It egins with only £3,000 a year, "to enable e Trustees to fulfil their trusts." It ends ith about £200,000 a year. The current cost the main curve, and added above that is the ddition for buildings. To make it clearer is is drawn from the average expenditure in ach ten years, so as to avoid mere temporary hanges. The result is noble and encouraging. f we join up the lowest points of the curve, the east expenditure—we get some idea of where e are going. We see that, looking at Bloomsury alone, a quarter of a million a year will be eached before 1940; or, if we include Natural listory, we may be at over £350,000 by that me. Probably the total budget will be a nillion by the end of the century.

Now what would be the effect on this of aying for the great Repository which we proose, a repository equal to six times the ritish Museum? This is seen by the narrow pace with the words, "National Repository." hat space is the whole charge for it, building nd staff, as compared with the British Iuseum. The normal average increase of the loomsbury vote is £10,000 every four years of s history; even granting that half of this is or the library, its increase is £10,000 every ight years for the historical sections alone. Ience, leaving the museum budget to grow as normally does, if the Sloane enabled Bloomsury to expand during eight years by weeding ut, instead of by fresh building, the Sloane ould be paid for to all time, and Bloomsbury ould then go on on expanding at its usual rate. ut I should rather anticipate that the Treasury will some day shirk such an ever-increasing budget, and lay down a slower rule of expansion. If this is done before the Sloane is started, it will be woe to Bloomsbury; if, however, the automatic relief of space by weeding to the Sloane is in action, a check on expansion will not be so severely felt. It is the urgent interest therefore of the British Museum to see a clearing ground for its surplus antiquities and ethnology, as well as that started already for its papers and library lumber. With such a relief it might weather some unhappy days of national economy without feeling the blow to its growth. In this I proceed on the pessimistic assumption that we cannot go on as flourishingly as we have already done. If our prospects are really brighter, then the cost of the Sloane will be so much the less serious.

We have now reviewed the need of providing for expansion in the coming century, for which the Bloomsbury site and system is wholly inadequate. Before science is further suffocated by it, some larger relief is essential. We have considered how that relief can be attained, in the same proportion to our present needs that the present museum bore to the needs of a century ago. And we have seen that all that is absolutely required could be for ever provided on the present system of expenditure if the British Museum were to be weeded during eight years of its more cumbrous and less valuable contents, sufficiently to take in its new acquisitions. Such a course would be scarcely felt, and it would suffice to establish for centuries to come an abundant space for all the treasures of history which are certain to be ours if we will only open our hands and take them.

May we all meet twenty years hence down at Sloane.

DISCUSSION.

The CHAIRMAN said they had all listened to this paper with great interest and profit. Dr. Petrie was well known there; he had unfolded the history of human civilisation, and spoken on the subject with a full knowledge of what was required. The question was pressing, for many objects of great value for the future comprehension of the questions to which he had adverted, were perishing or being lost from neglect, and in many parts of the world the knowledge of these objects and of what they implied was being lost—passing out of the category of things, knowledge of which was possessed at first hand, into

that which were known of by hearsay, and often from the hearsay of persons imperfectly acquainted with them. In many parts of the world we had officials who had an aptitude for these studies, and were desirous of forming collections of an instructive nature. A friend of his, who died at the beginning of the present year, Mr. Leopold Layard, brother to Sir Henry, had a unique collection of antiquities which he had gathered in Tonga and the other Pacific islands, from the time of the cannibal regime, most interesting and valuable, and which once scattered, could never be replaced. It had been sent, he believed, by his son to Manchester, but he was not really aware what had become of it. The late Agent-General for New Zealand was present, and he could tell them how the antiquities of that colony were fast disappearing. The subject, therefore, required immediate attention, and the scheme itself seemed to him to be sound and practicable. But in this country it was not enough to put a scheme of this kind on paper—the practical question was how could it be brought into operation. If the authorities of the British Museum would take it up, nothing could be better, but it was very difficult to get such a body as the Trustees to put themselves at the head of such a movement. Some there would remember the difficulties which were raised in starting the Natural History Museum at South Kensington, and it seemed to him that perhaps the best way would be to try to bring about concerted action between the different societies which were concerned with these questions, perhaps the Society of Arts could obtain the adhesion of the chief societies. If some Committee of that kind could be formed, the proper authorities could be applied to with a better chance of success, either the British Museum or the Treasury, or perhaps they might induce some public spirited man to advance the sums required to put the scheme in operation.

Mr. HUGH STANNUS said this was an epoch-making paper; every line was charged with thought, and at the same time it was eminently practictal. It appeared to him that it might be divided into parts, and first there was the necessity for such a scheme, which had been proved up to the hilt, and then came the various points—what, how, and where? The what had been admirably shown by the plans, but he would refer to one or two other methods, and ask Dr. Petrie if he had considered them. The opportunity for expansion was a primary consideration, and he remembered a suggestion some years ago for a library, that it should be on the plan of an Archimedean spiral, which could be built on to in successive sections as required. That would do admirably for some objects; but inasmuch as Dr. Petrie's museum would have to provide for objects of many kinds, he feared it would not be suitable. Then he remembered, at one of the Paris Exhibitions, one building was ellipsoidal in form, the objects being classified concentrically, and the countries radi[ating,] thus affording an elastic method of arrangem[ent.] Again, would it not be possible to copy the de[sign] of a star-fish, additional galleries being a[dded] where required between the diverging arms? W[ith] regard to the preservation of complete example[s in] one central repository, as advocated by Dr. Petrie[, he] felt it was very saddening to go to such pl[aces] as Pompeii, and find that people looked u[pon] it as a place from which they could exh[ibit] marbles to decorate gentlemen's galleries, or [take] from the walls Græco-Roman frescoes to deco[rate] the museum of a neighbouring city; but he was g[lad] to think that a better spirit had come over them, [and] that now whatever was found on the walls [was] allowed to remain there, and the same with what [was] found on the floors, so that in the few new hou[ses] now preserved they had a true idea of what [a] Pompeiian house was like. Of course, if Dr. Pe[trie] thought it necessary to bring any of those things [to] his museum, he would bring the entire contents o[f a] house, or at any rate, a room. There had been so[me] attempts at South Kensington lately, under [the] management of Mr. Purdon Clarke, to put toget[her] rooms fitted with appropriate contemporary fur[ni]ture, and in that way the Museum became not mer[ely] a storehouse of valuables, but a place of educati[on.] The Museum of Retrospective Art at the Trocad[éro] in Paris was an admirable step in the right directi[on,] though it was limited to French architecture, and [did] not touch the larger question of archæology whi[ch] Dr. Petrie had so much made his own. He could n[ot] help thinking also of the Crystal Palace and its s[ad] fate. Twice a year he took parties of studen[ts] through those admirable art-courts, in which we[re] gathered together fifty years ago, with great enth[u]siasm, classified examples of historic art, and he cou[ld] only hope that Dr. Petrie's suggestion would have [a] better fate. With regard to locality, he ventured [to] think that between Hitchin and Watford and Guil[d]ford, there would be no room for such a museum, b[ut] thought a good spot might be found on some of t[he] high lying land, on 200 feet of sand, between Has[le]mere and Aldershot. He would probably have [to] give more than £50 an acre, but if he boug[ht] a square mile, he would be repaid in the en[d.] Even if he had to pay £200 or £300 an ac[re] for suitable land, it would pay eventually. Wi[th] regard to the cases, if anyone present wanted to kno[w] what could be done in the way of making case[s] admirably efficient, at a minimum of cost, he woul[d] recommend them to visit the little Egyptian museu[m] which was being got together at University Colleg[e,] presided over by Dr. Petrie himself. Local museum[s] had been referred to rather disparagingly, but he re[-] membered some in Greece, the two on the Acropoli[s,] one at Eleusis, and another one at Olympia, which h[e] should be sorry to see removed to Athens, becaus[e] they would all much rather see the remains in con[-] nection with the architecture to which they were onc[e] wedded. It was an admirable system to take away man[y]

igs from the British Museum, and thus leave more m for those which were really valuable, and if any ig would induce the authorities to look kindly on cheme of this kind, which was in no way in osition to them, but rather ancillary to their ects, it would be the possibility of providing them h such a safety-valve.

ir WESTBY PERCEVAL, K.C.M.G., said he had hing to offer in the way of criticism, and it occurred im if such a scheme were submitted to any hundred sons of ordinary intelligence ninety-nine would at e recognise its value and declare that it ought to carried ont. He heard the Chairman's remarks on best way of putting it into practice with much rest, because that really was the practical question. the authorities of the British Museum could be uced to support Dr. Petrie he might look for-rd with some confidence, and he quite recog-ed that it was not in any way antagonistic to Museum but quite the contrary. Such a sub- hardly appealed to the public, and he feared that vernments were inclined to take up only such jects as ensured a certain amount of popularity. t if it were properly kept before the public, it ild only be a question of time when it would be ognised that it was a work which in the interest of whole people should be carried out. He hoped present would do their best to support Dr. Petrie's ws, and though it would be premature at present discuss the details minutely, he might say that se submitted seemed admirable, and he preferred m to the more elaborate suggestions of Mr. innus.

Sir H. TRUEMAN WOOD said there was one point ich bore on the subject, to which no reference had en made in the paper. There was a Bill now fore the House of Commons empowering the ustees of the British Museum to get rid of some of eir superfluous literary matter, which proposal had en very severely criticised by Mr. Sidney Lee and ers. It appeared to him that the proposal of Dr. trie would meet this difficulty, and that if the elves of the Museum could be relieved of an ormous mass of useless matter, the library would come more useful, and the materials might be ually well-stored away at Woking, or wherever the w museum was situated. Of course there was the ger question of the accumulation of such matters, d he feared the historian of the future would be ore embarrassed by the superfluity of material, th which it would be impossible for him to deal, an the historian of the present was by its arcity. Every one who had any research to ake knew that it was more difficult to get work ne if you had too much to deal with, than if u had not enough. But the question of accumu-ing for posterity the materials with which, un-tunately, posterity would have to deal, was one apart from the other question of preserving for ourselves a record of the past. The argument against accumulating material did not apply when the value of that material was already ascertained by the test of age, and there could be no question that we ought to be able to preserve any such material as men like Dr. Petrie were good enough to accumulate for our benefit. It was a crying shame that men should encounter difficulties and danger in collecting such things, and that they should not be carefully used and preserved. With regard to the details of the building, he would remind Mr. Stannus of the great cost of erecting a building on what he might call the snail-shell, or ammonite principle. Various lowly organisms built their houses in that manner without any difficulty, but if a human builder attempted to imitate them, he met with considerable difficulties, and the work was very costly. The arrangement tried in Paris in 1867, to which Mr. Stannus had referred, was an admitted failure. He did not see much difference between the so-called star-fish arrangement and the circular; at the Barcelona Exhibition, the principal building was semi-circular constructed in star-fish fashion, with radial and concentric galleries; but it did not answer very well. Curved galleries were inconvenient for most purposes and they were very costly to build. He thought the plan of Dr. Petrie was simpler and better in every way.

Mr. J. CAWSON thought some further elucidation of the financial side of the question might be given. The suggestion was that land could be purchased at £50 an acre, but he was inclined to agree with a previous speaker that it might be preferable to pay a higher price for more suitable land; he doubted if a suitable site could be obtained for that figure. Then it was suggested that £4,000 a year should be set aside for interest and amortization, but he apprehended that if the proposal were taken up by the Museum authorities and the Government, that would not be necessary. The actual cost of the buildings themselves did not seem to have been gone into.

The CHAIRMAN proposed a hearty vote of thanks to Dr. Petrie, which was carried unanimously.

Dr. PETRIE, in reply, said he was rather surprised that more difficulties had not been raised, but it might be due to the fact that this scheme was brought forward some years ago before the British Association, when a small committee was formed to consider it, and an outline was placed before most of the authorities interested. He had had the advantage of considering all the objections and difficulties they raised, and so far as they seemed to be inherent in that preliminary scheme he had tried to avoid them. The present paper was the result of a discussion of the matters by most of the persons who had detailed and technical knowledge of the subject. He was much

indebted to the Chairman for his suggestion, and for his own part being away from England, engaged in practical work in the field a great part of every year, he should be only too glad for anyone to step forward, take up the scheme, and push it forward. With regard to the suggested designs the star-fish pattern was fascinating in many ways, and for some purposes was admirable—where you required central supervision, as in the reading-room at the British Museum; but one difficulty in a general museum was that you could not concentrate in the central part those things which required least expansion, and you never knew what department would require expansion. For that reason, you had to have an equal amount of space at command at every part, and that was why he preferred the parallel arrangement. He fully agreed with the idea of keeping charming groups of things which were found together at Pompeii and such places intact; it was delightful in the climate of Italy, but any Roman remains found in England perished miserably if left exposed. You must either bury them, or build a roof over them. Even Pompeii was rapidly disintegrating; you saw pavements breaking up and perishing, and excepting the parts which were roofed in, glazed, and protected, there would be nothing worth seeing in a century or two at the present rate of decomposition. This was far more the case in England. Even the Roman pavements at Bignor were steadily decaying, and for this reason he had no confidence in preserving things locally. Local museums were invaluable for elementary teaching, and that was their proper function in England. In many of them there were admirable series in natural history and antiquities, concise and compact, from which a person got a general idea of the whole subject, but to preserve valuable or irreplaceable things in such a museum was very dangerous. The case was somewhat different in Greece, where the sites were unique and interesting, and no doubt a great part of the charm of many things there depended on their association with the neighbourhood. Still he remembered in the museum at Mycenæ large baskets full of things any one of which would be a fortune to an English museum, all huddled together, pottery and bronze work, getting dirtier every day, and more injured and exposed to petty thefts by visitors. With regard to the price of land, he had looked into it very carefully, and had not included any which was distinctly unsuitable. There was lots of good sandy land advertised for sale at Woking for £50 an acre, which you could buy by the mile if you wished. But if it were necessary to pay a higher price the cost of land was such a small item that he should not stick out about £100 if necessary. With regard to the cost of the galleries, he had asked a very competent friend to give him an estimate, with good workmanship, with a cement floor, and iron and slate roof, and it was on that estimate his figures were based, viz., £200 for every 16 ft. bay. He had, however, avoided going into detail as much as possible, and had mentioned certain matters, such as the cost of ph graphing, in order to meet possible objections, w he had heard raised before, as being fatal to scheme. He knew how many plates could be in a day, and the cost of materials, and he had allowed for a man doing half as many as he c do himself. He did not wish it to be suppc that all these details must be accepted, was the general scheme only he wished insist upon. They must either have an enorm amount of expansion, must let the things remain wh they were, or must give them away to other countr At present we were giving to America quantities things we could not find room for. He had ag and again written home from Egypt asking he should send things he had found, or if th should go to America, and they had had to go Philadelphia, because there was no room in Engla Under these conditions, he ventured to say that th must have a place to which the present museum commodation was comparatively insignificant. they expanded, a cheap mode of expansion was ab lutely necessary, and for that reason he had broug forward this scheme.

Correspondence.

THE IMPROVEMENT OF OUR ROADS

During the reading of Mr. Moresby White's adm rable paper, on Wednesday last, several poin occurred to me, which might, I thought, have bee elaborated with advantage by after speakers, bu with the exception of Sir John Wolfe Barry, none the speakers appeared to touch the details of roa making, and no definite suggestion was made as t the means of compelling defaulting local authoriti to attend to their highway responsibilities.

As an old municipal official, I know something c the local authorities' side of the question, but I an now continually engaged on cases against Count Councils and other local authorities who may be tryin to burke their responsibilities with regard to keepin their roads up to a proper standard of strength. thus have an acquaintance with the road users' griev ances, and from experience gained in many parts o the country, it appears to me that the main faults i our roads are due to the following three causes:—

(1.) To parsimony.

(2.) To faulty details of construction.

(3.) To insufficient care of the road between time of re-coating, and inattention to side drainage grips.

The question is, How are these three difficulties t be surmounted?

I will attempt to indicate the line along which th solution must, in my opinion, sooner or later come but first of all it is essential that District and Count

incils shall fully grasp the fact that the cycle is onger a mere luxury, but is becoming more and re a business necessity. To bring home this fact, certed action is necessary, and considering how ny cyclists there now are this should not be a very icult matter, although it will probably be necessary ask Parliament for an amendment of the Highways ts, so that defaulting local authorities may be ilt with (on appeal) by the Local Government ard, in the same way that they can be compelled provide and maintain an adequate system of main verage under Section 299 of the Public Health t.

With reference to parsimony, there are, of course, o sides to this question, but the fact that, the past, District Councils have had to spend ormous sums on the land purification of sewage has ndicapped them greatly in their other expenditure. e sewage farm is the local authorities' most vulner- le point, that is to say, they are more in danger of urring heavy law expenses through lack of proper rification, than they are of suffering through glect of any other of their manifold duties. It is, erefore, somewhat natural that the proper main- iance of sewage works should have formed a first arge on the rates, but I firmly believe that with the vent of the bacteriological process of purification, eat expense will be saved to the ratepayers, not ly on capital account, but also on current expendi- re, and so much more money will be available for e repair of highways.

With reference to faulty details of construction, can endorse much of Mr. White's paper, but I ink Sir John Wolfe Barry touched the main cause failure and clearly pointed out the remedy when he id that if only the road materials used in the undation of same were treated as on the ballasting a railway, great advantage would obtain.

I have for a long time maintained and stated that a nd-packed layer of hard core $4\frac{1}{2}$ inches thick, will stain quite as much as 12 inches of hard core tipped to the road formation in the way one sees it done w. In the one case there would be practically no terstices, bnt in the other case, even when the loose re has been steam-rolled, the proportion of voids to lid material is very considerable, and leads to settle- ent of the road crust.

Another point which is worth attention is the way which granite macadam roads are put together. e old metalling, after it has been scored over, con- ins a large percentage of mud and small fragments granite which have been broken by attrition from e larger cubes. A new layer of stone is put down d smothered, in many cases, with fine gravel hoggin, d occasionally with dried macadam slop, and then itered.

To my mind, both of these practices are entirely ong. In the one case the voids between the stones e filled in with wet slop, which has no holding power iatever, and on the approach of dry weather it shrinks d the stones work loose. In the other case an attempt is made to "key-up" an angular material with circular stones, which is not exactly a scientific proceeding. From my own experience of road maintenance, I can say with absolute confidence that angular stones should be bound together with angular material, if the road is required to maintain its shape.

Another contributory cause of failure is to be found in the fact that some surveyors appear to have an idea that it is an advantage to mix different kinds of granite. Few greater mistakes can be made, as no two kinds of granite have exactly the same wearing factor. The proportion of Felspar (the potash of which causes the decomposition) is very variable, being exceedingly high and unequally distributed in the Cornish granite, and comparatively low in the best varieties of road-making stone. The fact, therefore, of mixing granites is practically bound to result in holes forming in the surface of the road.

A suggestion was made at the meeting with reference to the use of slag as a road covering. I must say that I was somewhat surprised to hear this suggestion put forward seriously, as there is no material which is so readily influenced by atmospheric changes as slag, and without the assistance of very much traffic it will decompose itself away in a remarkably short time, especially in wet situations, and the smell is so objectionable, that some time since, one of the large Vestries near this office had to remove a section of slag paving which they had laid.

Unfortunately, there does not seem at the present moment to be very much agreement between the surveyors to local authorities on the question of road maintenance, and the vicious practice which some District Councils, unfortunately, have of electing men of the broken down jerry-builder class for their surveyors, makes one feel almost hopeless with regard to the future, unless the office is made a branch of the Government service. I have long believed that this would be the best in every way, and I have met a number of influential men who hold a similar opinion. In this way trained scientific men only would be employed, and whilst one knows that the passing of an examination is not sufficient, *per se*, to put the hall-mark of capability on a man, yet it is the best method we have at the present time, and it would be immeasurably preferable to have the failures amongst municipal surveyors, formed of a few scientific men who could not apply their theory to practice, rather than a large percentage of so called practical men (of the type I have mentioned above) to whom both theory and practice are unknown quantities.

There is one element which, at the present time, should be a source of joy to the cyclist, viz., the motor-car. During the next few years the influence of these vehicles must be felt throughout the country, and their substitution for horse traffic will result in a vast annual saving in road wear, as from experiments made a few years since, the hammering action of the horses' hoofs was proved to have been responsible for some 45 per cent. of the total road destruction, whilst

atmospheric changes brought about 20 per cent, and wheels 35 per cent.

With reference to the inadequacy of road mending between the times of wholesale repair, I fear that cyclists have, to some extent, to thank themselves, as I have again and again seen letters from wheelmen who felt themselves outraged by the appearance of a few small patches of unrolled granite on a long length of road. It must be borne in mind that it is quite impossible for a local authority to keep a roller employed only on rolling in materials used in repair, but on the other hand if repairs are properly done there should be very few cases where it would be necessary to put down loose stone for any length or width which would cause inconvenience. Repairs should be made the instant depressions occur, and the materials should consist of small stones which readily work themselves into the road, especially if the same be loosened slightly underneath.

H. Howard Humphreys,
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332, High-road, Kilburn.

"Wet sand" will not carry a heavy load, *e.g.*, a quicksand; but fine-grained sand that has been well pounded by the waves is compact, and is able to carry a moderate load.

Dry powdered clay, sandy clay preferred, well brushed into the interstices of compacted stones, becomes a good binding material. Gravel, if small-grained and loamy, is also serviceable; but chips or stone screenings, unless of limestone and easily crushed to powder, do not make a binding material.

The Telford sub-pavement is well suited to all cases of unsound, yielding road-bed, not merely to wet places. There is an economy in providing always a good foundation for a road-crust, and as the toughest, hardest stone is used for the road surface layer, while the sub-pavement may be of softer stone, the idea that the upper metal is liable to be ground between the blows of the traffic and the sub-pavement may be dismissed as of remote value.

There are good granites for road-making, just as there are inferior, and the same holds good with basalt or trap-rock; there are also good quartzites. The syenites, when well selected, are, perhaps, on the whole, the best. "Field and river stones" is a vague term, covering anything from flint and cherty stones to limestone, sandstone, quartzite, &c.; field flints are generally less brittle than than those newly brought out of the chalk.

Water-brakes (? breaks) whether in the form of mitre or cross-mitre gutters, are seldom made, except on rough, steep lanes.

The toothed rake is an injurious weapon in the hands of a road-man; much better are the broad, thick-bladed scraper and the besom; the rake and the thin metal scraper are liable to drag out stones from the road-crust. Dust and mud should be removed as soon as formed, and roadmen should always be supplied with waterproofs, so that they may be out on the road in wet weather and spy out incipi ruts and hollows.

"When the surface requires renewal it is best pick out a cross section and carefully re-make whole." Presumably this means that a conveni length of road-crust is "picked up," *i.e.*, loosen and then remade with new metalling, well rolled correct profile on cross section, and thoroughly co pacted with suitable binding material. In some ca a length of the half-width of the road is dealt wi Trees growing on the southern and western sides the road are generally injurious, keeping off the dryi sun and winds. Trees on the north to east side m be some protection to the wayfarer. Hedges, unl too thick and high, and too near the road, cannot accepted as injurious. A wet road surface is weal and wears away more rapidly than a slightly da one, and if the binding material cementing the sto together is of good quality, the surface of the ro may be quite dry without detriment. If ordina dryness causes a loosening of the stones, t cementing material is of inferior quality. "Bas blocks" and "stone sets" are terms that may co the same thing. There are good basalt blocks in tl country, *e.g.*, from Penmaenmawr, North Wales; t Clee Hills; the Whinston ridge in North-East Yor shire, &c.; and the modern introduction from bas quarries abroad is, I conceive, really a question cheapness of production and carriage by water this country. The use of basalt is no new thing.

"The irritating convexity we find in the blocks stone-paving" is due to a wide joint between tl blocks, filled with weak material, and to the use of stone easily crushed on an edge.

Tar macadam, when properly mixed and lai makes an excellent road. Well-boiled gas ta thickened with pitch and powdered lime, is thorough mixed with hot, dry, clean stones of all sizes, an when rolled down into a compact mass, forms nearly impervious road-crust.

A good road should have a firm, unyielding, wel drained road-bed, or foundation. The under layers the road-crust may be of larger sized stones, while th surface layer should furnish a close jointed mosaic hard tough stones of a moderate range of sizes, a well-cemented together with a substance not liable t serious deterioration, either in wet or in dry weathe and strong enough to hold the stones firmly in plac under the traffic of horses' hoofs and wheels o vehicles.

A. H. Heath.

Cooper's-hill, May 14th, 1900.

Miscellaneous.

PRODUCTION OF CASSAVA IN ARGENTINA.

Cassava is a native of the Argentine Republic. It has a long, fleshy, tuberous root, often weighing 30 lbs., and full of a wheyish, venomous juice. The

ms are white, crooked, brittle, jointed, pithy, ıally 6 or 7 feet high, with a smooth, white bark. e United States Consul, at Buenos Ayres, says ıt this plant, formerly designated by botanists as *Jatropha manihot*, furnishes a large amount of ıd to the inhabitants of South America, under the ne of mandioca, tapioca, or cassava starch. There two distinct species of the plant. The root of is brown externally, not exceeding 6 ounces in ight, with a sweet taste, and may be eaten with punity; it is termed sweet cassava. The root of other, and more common variety, is much larger, otty, brack externally, and contains a milky and isonous bitter juice; this is called bitter cassava, l contains free hydro-organic acid, starch, an ganic salt of magnesia, saccharine matter, a bitter nciple, a crystallisable fatty matter, and phosphate lime. Each of these plants furnishes a considerable antity of starch. Tapioca is prepared from the ter cassava. The large fleshy and tuberous root is luced to a pulp, which is washed with cold water funnel-shaped mat filters. The starch is allowed to ›side in the milky fluid which passes through, and finally converted into the granular form by drying on hot plates. Should any of the volatile poisonous nciple remain in the meal previous to drying, the ıt employed for that purpose entirely removes it. pioca is a very pure starch, in the form of irregular rty grains, seldom larger than a pea, white, taste-s, and inodorous. Boiling water dissolves it almost tirely, or if in small proportion to the tapioca, it ms with it a translucent, tasteless jelly, firmer than made with most varieties of starch. Under the croscope it is found to consist of aggregated starch ›bules, about the two-thousandth of an inch in ımeter, partly broken, partly entire.

IE SCHWEITZER SYSTEM OF BREAD-MAKING IN PARIS.

There has recently been established in Paris a ːiety for forming in all the populous centres of ance, combination milling and baking houses, ›rked by machinery known as the "Schweitzer stem." The object is to furnish 100 kilogrammes ›o lbs.) of nutritious and digestible white bread ›m 100 kilogrammes of grain at the lowest cost production. The United States Consul at oubaix in his last report says that the model tablishment, which is at La Villette, Paris, ened its doors to the public on June 15, 1899. may be visited on Sundays by those desirous of ıdying its operation. At a meeting of the ciety in December last, a report was made con-rning the success of the effort to supply good ead at a low price to the Parisian public. In e bakery at La Villette, and in the branch uses sales are rising daily. Official analyses by e National Agronomical Institute and by the unicipal laboratory of Paris demonstrate that the :hweitzer bread contains more nutritive nitrogenous properties than ordinary baker's bread, and more than double the phosphates in the latter. The bread known as *pain de menage* is sold to the working-classes at about 1¼d. per pound, considerably less than the usual price. The Villette establishment is a building of iron and stone, about 515 feet long, situated on a canal, and constructed at a cost of about £40,000. The wheat arrives in a boat, which is moored in the canal, elevators hoist it into bins, whence it is carried by an immense elevator to the top of the mill, and turned into the different cleaning and separating machines. After all foreign substances have been removed and the grains of wheat have undergone a thorough brushing and washing, they are clean and shining; but the grooves of the wheat sometimes retain a little dust. This is completely eliminated by a Schweitzer appliance, which, seizing each grain lengthwise, splits it exactly in the groove. The wheat thus cleansed passes into the mill, composed of flat circular steel grinders, grooved in such a manner that they accomplish the decortication of the kernel and its granulation into meal at the same time. These grinders are movable, but do not touch, so that instead of crushing the wheat and producing a flour in which the starch only is retained, the outer and harder portion of the wheat, containing gluten and other nutritive properties, is retained in the flour. The bran alone is expelled. Attached to the mill are the works for kneading the meal, water, and yeast into bread. All this is done mechanically, the works being separated into three stories. Special yeast is prepared into the upper story in rooms heated in winter and cooled in summer. The yeast, flour, and the salted and filtered water are carried down by machinery into kneaders, in the form of half-cylindrical tubs, rotating on two pivots placed in the axis of the kneading-troughs, so that the tubs may be placed at a lower or higher angle, in order to accelerate or retard the kneading. The wheat, salted water, and yeast automatically enter one end of the tub, and dough, in an endless skein of pale yellow, issues from the opposite end. This dough finally falls on tables on the ground floor, where it is weighed and made into bread of every shape and dimension. In connection with this model establishment is a laboratory for the chemical examinations of the samples of wheat submitted for purchase. These are, upon arrival, ground and passed through a sieve by a small hand-bolting mill, which determines immedialy the nutritive volume of the grain in gluten aud nitrogenous matter. This Schweitzer system is to be on view at the Paris Exhibition.

General Notes.

Congress of Hygiene and Demography.—The Tenth International Congress of Hygiene and Demography will be held in Paris this year, from

August 10th to 17th, under the Presidency of Dr. Brouardel, Dean of the Faculty of Medicine of Paris. The subjects which will be discussed at the Congress are classified as follows:—I. Hygiène: (1) Microbiologie et parasitologie; (2) Hygiène alimentaire; (3) Salubrité—Sciences de l'ingénieur et de l'architecte appliquées à l'hygiène; (4) Hygiène individuelle et des collectivités (première enfance, exercices physiques, écoles, hôpitaux, prisons, &c.)—Crémation; (5) Hygiène industrielle et professionnelle—Logements insalubres; (6) Hygiène militaire, navale et coloniale; (7) Hygiène générale et internationale; (8) Hygiène des transports. II. Démographie. Programmes and forms of application for membership can be obtained from the Secretary of the British Committee, Dr. Paul F. Moline, 42, Walton street, Chelsea, S.W.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MAY 23.—"Salmon Legislation." By J. WILLIS-BUND. WILLIAM SENIOR will preside.

MAY 30.—"Russian Central Asia: Countries and Peoples." By A. R. COLQUHOUN. SPENSER WILKINSON will preside.

INDIAN SECTION.

Thursday afternoons at 4.30 o'clock:—

MAY 24.—"English Criminal Procedure and the Indian Code of Criminal Procedure: a Comparison." By SIR JOHN SCOTT, K.C.M.G., D.C.L. The Right Hon. SIR FRANCIS HENRY JEUNE, K.C.B., D.C.L., will preside.

FOREIGN AND COLONIAL SECTION.

Monday afternoon at 4.30 o'clock:—

MAY 28.—"Imperial Telegraphic Communication." By SIR EDWARD SASSOON, Bart., M.P. The Right Hon. SIR HENRY H. FOWLER, G.C.S.I., M.P., will preside.

APPLIED ART SECTION.

Tuesday evenings at 8 o'clock:—

MAY 22.—"The Practice of Lettering." By EDWARD F. STRANGE. WALTER CRANE will preside.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

Prof. VIVIAN B. LEWES, "The Incandescent Gas Mantle and its Use." Three Lectures.

LECTURE III.—MAY 21.

The Gas Burners employed in Incandescent Lighting.—The theory of the Bunsen burner—The adaption of the Bunsen burner to the incandescent mantle—Modern burners and their aims—The effect of the chimney — Chimneyless burners — High - pressure burners—The influence of the quality of the gas on the conditions of burning—The use of water-gas in incandescent mantle burners.

MEETINGS FOR THE ENSUING WEE

MONDAY, MAY 21...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. (Cantor Lectures.) Vivian B. Lewes, "The Incandescent Gas Ma and its Use." (Lecture III.)

East India Association, Westminster Town-S.W., 4 p.m. Mr. V. R. Gandhi, "Contribu of Jainism to Philosophy, History, and Progr

Surveyors, 12, Great George-street, S.W., 8 Mr. E. H. Blake, "Extras and Omission Building Contracts."

Geographical, University of London, Burling gardens, W., 3 p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 Mr. J. M. Brydon, "The Art of the late Profe Cockerell."

Medical, 11, Chandos-street, W., 8½ p.m. An Oration.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ Rev. Dr. Wace, "Ethics."

TUESDAY, MAY 22...SOCIETY OF ARTS, John-st Adelphi, W.C., 8 p.m. (Applied Art Secti Mr. Edward F. Strange, "The Practice Lettering."

Royal Institution, Albemarle-street, W., 3 Dr. A. Hill, "Brain Tissue considered as Apparatus of Thought." (Lecture II.)

Medical and Chirurgical, 20, Hanover-square, 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Alfred Watkins, "Hydroquinone and Col Impressions."

Zoological, 3, Hanover-square, W., 8½ p.m. 1. P G. B. Howes and Mr. H. H. Swinnerton, B. "The Development of the Skeleton of the Tuat *Sphenodon (Hatteria) punctatus*." 2. Rev. T. R. Stebbing, "Crustaceans from the Falkl. Islands collected by Mr. Rupert Vallentin." 3. Walter Kidd, "The Significance of the Hair-sl in certain Mammals.

WEDNESDAY, MAY 23...SOCIETY OF ARTS, John-str Adelphi, W.C., 8 p.m. J. Willis-Bund, "Saln Legislation."

Geological, Burlington-house, W., 8 p.m.

Royal Society of Literature, 20, Hanover-squa W., 1 p.m.

THURSDAY, MAY. 24...SOCIETY OF ARTS, John-str Adelphi, W.C., 4½ p.m. (Indian Section.) Sir J Scott, "English Criminal Procedure and Indian Code of Criminal Procedure: A Co parison."

Linnean, Burlington-house, W., 3 p.m. Ann Meeting.

Royal Institution, Albemarle-street, W., 3 p Rev. Canon Ainger, "Chaucer." (Lecture I.)

Electrical Engineers (at the HOUSE OF THE SOCI OF ARTS), 8 p.m. Annual Meeting.

FRIDAY, MAY 25...Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting, 9 p.m. Mr. Fran Fox, "The Great Alpine Tunnels."

Clinical, 20, Hanover-square, W., 8½ p.m. Ann Meeting.

Physical, Chemical Society's Rooms, Burlingt house, 5 p.m. 1. Prof. S. P. Thompson, "E periments illustrating the Aberration called Coma 2. Mr. R. T. Glazebrook, "Notes on the Measu ment of some Standard Resistances." 3. M J. J. Guest, "The Strength of Ductile Materi under Combined Stresses."

SATURDAY, MAY 26.. Botanic, Inner Circle, Regent's-par N.W., 3¾ p.m.

Royal Institution, Albemarle - street, W., 3 p Sir Frederick Bridge, "The Growth of Chamb Music." (Lecture I.)

Journal of the Society of Arts,

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FRIDAY, MAY 25, 1900.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CANTOR LECTURES.

On Monday evening, 21st inst., Professor 'IVIAN B. LEWES delivered the third and ist lecture of his course on "The Incan-escent Gas Mantle and its use."

On the motion of the Chairman, a vote of ianks was passed to the lecturer.

The lectures will be printed in the *Journal* uring the summer recess.

INDIAN SECTION.

Thursday, May 17, 1900 (at the Imperial istitute); The Right Hon. LORD GEORGE [AMILTON, M.P., in the Chair. The paper :ad was "The Industrial Development of idia," by JERVOISE ATHELSTANE BAINES, .S.I.

The paper and a report of the discussion ill be published in the number of the *Journal* r June 8.

APPLIED ART SECTION.

Tuesday, May 22, 1900; WALTER CRANE i the chair. The paper read was "The Prac-ce of Lettering," by EDWARD F. STRANGE.

The paper and a report of the discussion ill be published in the number of the *Journal* r June 15.

CONVERSAZIONE.

The Society's *Conversazione* will take place t the Natural History Museum, Cromwell-ɔad, S.W. (by permission of the Trustees of ıe British Museum), on Wednesday Evening, ıe 20th June, from 9 to 12 p.m.

The following portions of the Museum will be open:—On the Ground Floor—the Central Hall, British Saloon, and the Fossil and Mammalia and Reptilia Galleries; on the First Floor—the East and West Corridors.

Each member is entitled to a card for himself (which will not be transferable), and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the *Conversazione*. On that day the price will be raised to 7s. 6d.

These tickets will only be supplied to persons presenting members' vouchers (which can be obtained from the Secretary) or a letter of introduction from a member.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 23, 1900; WILLIAM SENIOR in the chair.

The following candidates were proposed for election as members of the Society:—

Anson, Sir William Reynell, Bart., M.P., D.C.L., All Souls' College, Oxford.
Hoghton, Captain Frederick Aubrey, United Service Club, Simla, Punjab, India.
Jacob, Lawrance, The Lodge, Randolph-crescent, Maida-hill, W.
Pignatorre, George, Messina, Sicily.
Salter, William Henry Gurney, 26, Abingdon-street, Westminster, S.W.
Trotter, William, 31, Throgmorton-street, E.C.
Whittaker, John, J.P., Brookside, Wilpshire, near Blackburn.
Williams, Edward, 127, St. Domingo-vale, Everton, Liverpool.

The following candidates were balloted for and duly elected members of the Society:—

Armstrong, Frederick, British Consulate, Milan, Italy.
Engleheart, Sir J. Gardner D., K.C.B., 28, Curzon-street, Mayfair, W.

Jones, Frederick William, Barwick, near Ware, Herts.
Pinkerton, Surgeon-General John, M.D., Queen's-park-house, Langside, Glasgow.
Seymour-Jones, Alfred, Pendower, Wrexham.
Whittall, Sir James William, Constantinople, Turkey.

The paper read was—

SALMON LEGISLATION.

By J. W. Willis-Bund.

Is salmon legislation any real use? I was led to ask this question on reading the following document which is among the Worcestershire records. It is dated 1613, and is a petition from

> "certain fishermen of the counties of Worcester and Salop, many hundreds in number, to the Worcestershire Quarter Sessions, complaining that certain countrymen of Upton-upon-Severn, Ripple, Holdfast, and other villages bordering upon the said river, work with forestalling nets which reach from one side of the river to the other and from the top to the bottom thereof, so that they take multitudes of fish, namely about sixty salmon at a draft, and the rest that they take not they drive back that they cannot come up the said river by reason thereof. Your petitioners are like to perish, the said river being thus destroyed for fishing. Your petitioners several times petitioned against the offenders, and they were indicted at several sessions of the peace holden for the county, and lastly there was an order granted by John Wilde, Lord Chief Baron, and Roger Hill, Judge at the last assizes held at the said city, restraining such persons using such forestalling nets, as by the said order appeareth, yet nevertheless the said offenders do continue the said unreasonable nets. Your poor petitioners therefore most humbly beseech your worships that you will be piously pleased to grant your general order that all such persons may be restrained that so offend and persist against the good of the kingdom, whereby your petitioners may have some livelihood to subsist with all, and in obedience duty bound will ever pray, And this for God's love."

With the exception that the fishermen are, I had almost said, fortunately, no longer hundreds but units, and that they do not catch 60 salmon at a draught, but have to put up with one; the petition represents the state of things complained of to-day. Nearly 300 years ago the upper men said the lower men by their netting were destroying the rivers for fishing. Act after Act of Parliament has been since passed dealing with the matter, but still the complaint of the fishermen of 1900 is identical with that of the fishermen of 1613. Under these circumstances is salmon legislation any good? it would be impertinent in me to answer question, a Royal Commission has just b appointed to inquire into the salmon fishe of England, Wales, and Scotland, and one the matters they are asked is whether legislation is desirable. But while leaving answer of the question to them, it may be wholly out of place, assuming they sho think it is, to indicate the lines my hum experience shows that legislation should p ceed upon, so that if my ideas are controver there may be an opportunity for the Co mission to consider if any proposals are ri or wrong. There has been legislation enou and to spare on fishing matters, especially u upon salmon. Since the petition of 1613, so 20 Statutes have been passed on the subj Forty years ago a fresh start was made, the laws as to salmon up to that date were pealed, a new departure took place, since th some half-dozen or more fresh Acts h become law, so that whatever may be answer to the question as to the usefulness legislation, it cannot be said the salmon fishe have not had enough and to spare.

The principles that were laid down in 1 were these:—

I. A free passage for the fish up and do the river at all times.

II. Prohibition of taking salmon at impro times.

III. Restrictions on taking salmon at pro times.

Legislation has to a great degree secu the first, so far as legislation can. Th are various amendments in the existing required, but when salmon are obstructed their passage, it is in nine cases out of ten the fault of the law but the fault of the w the law is carried out. Fish passes have be erected which are admirable for everythi but for passing fish. Fishery Boards h not the money to alter them, and, if they h it is often true that their alterations, even wh officially approved, are of such a nature "th the last state is worse than the first." It not necessary to take up time by detailing necessary amendments, it may be taken th in the main, legislation has in this resp done its part.

II.—On the second point, prohibition taking salmon at improper times, legislati has done nearly all that can be expected fr it. Amendments are also required he but they are technical and of minor impo ance. If the law as it stands was efficien

rried out, the capture of salmon at improper nes would be in such cases presented. There e, however, two points on this that require nsideration—(1) What is the proper time for king salmon? and (2) How far should it be wful for salmon to be legally sold during the ohibited time?

(1). The first point—as to what is the proper ne for taking salmon—is one on which great fference of opinion exists. In England and 'ales, unless the rule is altered by a local byw, it is from the 1st of September to the 2nd of ebruary. On certain rivers this time has been ortened. The close time differs in Scotland id in Ireland. In my opinion the close time too short, at all events, having regard to e stock of fish now existing in the English id Welsh rivers. I think fishing should cease rtainly on the 15th of August, and as much rlier as possible, and not begin until the t of March, throughout England and Wales, id that this should be the irreducible minium. Boards might have power to increase but not to decrease it. This is assuming at there are to be different close times for igland, Scotland, and Ireland; if they are t, and one uniform close time for the United ingdom could be established, some sacrifice ight be made to carry out so desirable an ject. But this sacrifice should be rather the spring than in the autumn.

(2). The second point—how far should salmon legally sold during close time?—is one on iich great difference of opinion will always ist. The counsel of perfection is—uniform ose time, no sale. That is, however, I fear, attainable. All that can be done is to get near to it as possible. At least one-half e good of close time is done away with by e sale of salmon during close time being legal. it was not for what the Fishmongers' Comny have done, and are doing, in putting a op to the illegal sale of fish in close time, the esent system would be an absolute failure, e only reason why it works at all is that the Company's action the danger of tection deprives the poacher of his market. it if the Boards were left to themselves ey could not carry out the law, as they uld not act out of their district. On is point, further legislation is desirable, but fore it can be usefully undertaken the queson as to the extent of close time must be ttled, and also the question as to uniformity close time.

3. If legislation has been fairly satisfactory the first two points, on the third—the restrictions on taking salmon at proper times—it has been most unsatisfactory, and if legislation is to help the salmon fisheries, this is the direction it must take. At present, the state of things is most objectionable, and, short of cutting the Gordian knot, it is extremely difficult to see a satisfactory solution of the question.

Salmon are legally taken otherwise than by rod in two classes of engines—(*a*) fixed, (*b*) moveable.

(*a*). Fixed engines are the most destructive form of taking fish. As far back as the time of Henry VI. the necessity for placing restrictions on their use was recognised, and laid down in the words, "That men tire and engines do not," but, in spite of restrictions, fixed engines largely increased. In 1861, all new fixed engines were made illegal. In 1865, the legality of all engines existing in 1861 was inquired into, with the result that a very large number were declared illegal; speaking broadly, at present it may be taken that there are hardly any fixed engines for salmon that can be legally used in non-tidal water. The number that can be used in tidal water is limited, and owing to different circumstances the full number that can be legally used is not. While it would be very desirable to get rid of all fixed engines, this could only be done on paying the owner compensation, and as fish must be caught for the market, it is a question whether the fixed engines do not supply the public want as well as anything else. In my opinion they do not, if for no other reason than this, that the quality of the fish taken in them is inferior to that of those taken in movable engines, but it is a point on which a difference of opinion can well exist.

(*b*). The difficulty arises with moveable engines. In most rivers the bulk of the fish are caught in moveable nets, which are used near the limit of the tide. As the fish come in from the estuary or sea to ascend the river they meet with these nets, and are caught in large numbers. In effect, the fish that can get up the river are only the fish that can get past these nets, and fishermen, who know their business, will take care that very few get past. Here is where legislation is wanted. It should be illegal to work the nets as they are now worked, so as to deprive the fish of their chance of getting up the river. This has been attempted to be done in three ways, by restrictions (1) on the time of netting, (2) the kind of net used, (3) the mode of using it.

(1). The restrictions on time have been to

prohibit for a certain period during each week, from 12 noon Saturday to 6 a.m. on the Monday, all fishing. In a short river, or in a river where there is no netting allowed in the non-tidal parts, this might be effective, but in a large river, or where netting is carried on up the river for any distance, it is quite useless, all it does is to prevent the salmon being caught in the lower nets, so that they may be caught in the higher—it is robbing Peter to pay Paul. On the Severn some of the higher fresh water draughts are only fished on Mondays during the summer months. For weekly close time, as the interval is called, to be any real use there should be no netting above the tideway. Once the fish have run the gauntlet of the tidal nets they should, if taken at all, be only taken with a rod and line, and if legislation is to be effective this is one of the points to be insisted upon. It is often said, increase weekly close time; but to increase weekly close time, and not prohibit fresh water netting, would be a continuation of the evil, only changing the locality of capture. If fresh water netting were abolished an increase of weekly close time would help the river by increasing the stock. If it is not abolished the increase would only benefit, not the river, but the higher draughts in the lower reaches of the river.

(2). Restrictions on the kind of net—and Fishery Boards have now the power to say, and if they have not said it they ought to have done so, what kind of net may be used for taking salmon. In most cases above the estuary there is only one kind—the draught or sheet net—and if well worked it should take all the fish there are in the draught where it is used, two restrictions should be placed on it—(*a*) the length, or maximum length, can be fixed; this might, in some cases, have the effect of preventing all netting, as it would be quite useless to try to net a pool with a small net. The restrictions on length are matters that cannot be dealt with by legislation, and can only be dealt with by bye-law, having regard to local circumstances. But the length of the net is only one item. Another is the size of mesh, and on this there is a great diference of opinion. The legal size is two inches from knot to knot, or 8 inches round the square measured wet, but Boards have power to alter this. Most people think a large mesh desirable, but it is not certain that such is the case. A large mesh lets through a great number of immature fish, and if used in the summer and autumn the result is that the breeding stock of the river consists to a great degree of immature fish. How far this is desirable is v doubtful, but it lies outside salmon legislati and possibly the Fishery Boards have suffici power to deal with the mesh, without any furt legislation.

(3). The mode of using the nets is also some extent restricted, but here further legis tion is required. A pool should not be fishec that is, a net should not be drawn through more than once, or at most, twice on one ti If netting is allowed in non-tidal water, pool should not be fished more than once twelve hours. And a length of, say, at le a quarter of a mile, should separate t draughts. The fish would then have so chance of escape; now, if there is known to a fish in a pool the net is put through ti after time, until he is caught.

On the three subjects included in the 18 Act, it will be seen that the legislation that wanted is more in detail than in principle more to adapt the present system of protecti to the circumstances of to-day, than to int duce new methods. There are, however, otl matters which require attention.

One of the most important is the power water bailiffs. These want considerable e tension. A bailiff may search a man's basl but not his pocket; so as soon as a man w has anything illegal sees a bailiff he transf either the tackle or the fish from his basket his pocket, and meets the bailiff with a smili face.

The next is the administration of the la In many places Justices will either not convi or if they do, will only fine so small a sum really not to make it any punishment. A ve usual fine is 1s. without costs; a dish samlets, locally called trout, are quite wo that to eat and more to sell, and if they ha been artificially bred each fish would ha cost far more. What the reason is it m be difficult to say. In Cardiganshire it said a jury will never convict for she stealing, as the jurors never know that th may not be charged with the same offen themselves next day; possibly the same id prevails with some petty sessional Benche and the "fellow feeling makes the Justic wondrous kind."

The next point is the constitution of Fishe Boards. At present they are far too large be effective bodies. There is one district whe the number of Conservators exceeds the numb of salmon caught in a year. Conservators a not appointed for their knowledge of the subjec but from various other causes, and often tal

ery little interest in the matter. The question f the constitution of Fishery Boards is one hat requires grave consideration, but curiously nough it does not seem to be one of the subects that Royal Commissioners are to enquire nto. Then there is the question of money. t present no English or Welsh Fishery Board has enough money properly to do its luty. It may be if they had more money they night not do their duty, but they certainly annot do it unless they have it.

Salmon legislation cannot be confined to the Salmon Fishery Acts — there are other maters of vital importance to salmon that lie outside the Fishery Acts. The first is the quesion of fish other than salmon in salmon rivers. The inhabitants of large towns say, and with some justice, that they care not for salmon, except tinned, but they do care for angling, and hey demand that the rivers shall be looked after in the interest of the working man, and angling provided for him. What he wants are roach, dace, chub, bream, pike, perch, and the other freshwater fish, and Parliament have ried, as he is the master of votes, to meet his demand by tacking on to the Salmon Act freshwater fish, and giving to Fishery Boards the impossible task of jointly preserving salmon and freshwater fish in the same ream. So far, this happy family has been a failure ; the coarse fish are like Curran's fleas ; if they were only unanimous they would turn the salmon out, but their want of unanimity, shown by eating each other, only defers the ime, which must come, when they will have ejected both salmon and trout from the rivers. If salmon are to be preserved effectually, there must be a limit put on the coarse fish in salmon streams.

The next subject is one that affects both salmon and coarse fish alike—the pollution of streams. This is a matter that is yearly becoming more and more serious, not so much from the fish that are killed by pollution as from the fact that the rivers are made utterly unit for fish life. Salmon and trout are driven out of our streams by coarse fish because the coarse fish increase quicker, and eat up the food, so starving out the salmon ; but pollution kills the food and renders the position of the salmonidæ still worse. Lack of food prevents the salmon breeding, and further diminishes them, while the pollution destroys the places where they would breed by fouling the bottom of the river and rendering it unfit for breeding purposes or by depositing some deleterious substance that kills the ova after the fish have placed it in the spawning bed. The coarse fish do not feel this to the same extent, as they do not spawn on the bottom, but all the salmonidæ find that although the purified effluent may not be harmful to life it is to existence. The Local Government Board often say an effluent is fit to go into a stream, it is not poisonous, it has been treated. That may be true, but it is also true that although it may not affect life it affects food, and it affects the increase of the fish most seriously. Any salmon legislation that is to be effective will have to deal with the character of the solids and of the effluents that it is permissible to discharge into a stream.

To crown all, there is a new terror that local authorities have added to the fisheries, salmon and coarse fish alike, which, if legislation is to do any real good, must be dealt with —the abstraction of water from the rivers. The last notable instance is the London County Council which proposes by its Welsh Water Scheme to ruin the Towy and the Wye as salmon-producing rivers. The abstraction of a large quantity of the purest water from any river has the effect of intensifying the pollution. The cessation of the freshets which used to clean out the river, but which are now stored up in the reservoir prevents there being any "spring cleaning," and deprives the fish of any chance to ascend to the upper water in the late summer and early autumn. Also the diminution of the volume of the river prevents the spawning fish being able to get over the obstacles in ordinary times. The spawning fish are unable to occupy all the spawning ground ; they can only utilise that below the obstruction. This ground is turned over and over so often that a great deal of the spawn is lost.

To shew the effect of the abstraction of water the following figures from the Severn records may be of value. In 1890, the Liverpool Works, Lake Vyrnwy, were opened. The annual take of salmon since has been :—

	Number.	Average weight of each fish. lbs.
1890	13,500	12
1891	27,000	12½
1892	25,000	13
1893	14,000	13½
1894	11,500	11½
1895	13,000	12½
1896	18,000	13
1897	15,000	13¼
1898	8,500	13½
1899	10,000	12½

It will be seen that the total catch is decreasing, the size of the individual fish is increasing, that is, fewer fish are bred, and the river is living on its old stock.

The character of the river is completely altered. What was a river adapted for salmon becomes one far more adapted for coarse fish, so the result is that the change in the economy of the river is such that in most cases it is impossible to bring the river up to the producing power it formerly possessed. This should be dealt with in salmon legislation, and more protection given by Parliament against these ways of injuring the fisheries. At present they are at the mercy of any corporation or body that desires a big water scheme, and they have found that the tender mercies of corporations are cruel.

Such are some of the points to which legislation on salmon should, in my view, be directed. There should be some amendment of the existing law, the necessity for which the working of the existing Acts has demonstrated. Some provision is also wanted for protecting our rivers, not merely for protecting the purity, but for the prevention of their being made either receptacles for what ought not to be put into them, or reservoirs for what ought not to be taken out of them. With the conflict of interests, which is introduced in any attempt to deal with our rivers, it is far easier to point out what is desirable than to obtain it. If the proposals here indicated were submitted to any member of the Government as the basis for an Act, his answer probably would be the somewhat vulgar but very true one, "Don't you wish you may get it."

DISCUSSION.

The CHAIRMAN said this paper was the work of one who was a recognised authority, and who had devoted his mature life to the question of fishery legislation. As Chairman of the Severn Fishery Board, he had had that practical experience without which theoretical knowledge was of very little use. He had also had experience as Chairman of Quarter Sessions; and one of his greatest achievements was his reduction of the chaos of legislation on fisheries into something like order in his book on the Fishery Laws. Since the issue of that book, which still remained the standard work on the subject, he had published a half crown volume propounding a series of salmon problems, many of which were so difficult that no one had yet succeeded in solving them, and he would recommend its perusal to all who were interested in salmon, from the point of view, of sport, history, or food supply. Finally, only t[wo] years ago, Mr. Bund wrote a still larger book [on] the question of fishery management generally, so t[hat] they had been listening to a gentleman who spo[ke] as one having authority, and not as a scribe. [He] must confess to having smiled to himself at [the] quotation from the document 300 years old, in wh[ich] complaint was made that the fisheries were going [to] the dogs, because just the same cry was repea[ted] to-day; and as there were still fish to eat, a[nd] as the black-board had shown, not long a[go] there were something like 25,000 good salm[on] entering one river alone, the question might [be] asked whether there was anything substantial in th[ese] complaints. There was no doubt Nature was a gr[eat] restorer; and although man, through great stupid[ity] or greed, had been trying to baffle her, in the mat[ter] of fisheries Nature was a masterful customer, a[nd] both rivers and seas would take a good deal [of] fishing out. Still, during the last ten or twe[nty] years, the figures undoubtedly showed that [the] rivers were less productive than they had been. [It] was not that the fish became educated, a[nd] would not be caught, but they were not there, [as] they used to be. To take one river, the Annan, [it] used to be an amusement at the back end of [the] season to stand by the weir and see the salmon go[ing] over it up to the spawning grounds by dozens, but [in] the last three or four years it would have been oft[en] difficult, even with a magnifying glass, to see o[ne]. That river was practically ruined for the angler a[s a] salmon river. It was not yet ruined for the fisherm[en] at the mouth, who used their nets in the most destru[c]tive fashion. Last time he was there he walked do[wn] over the sands, when the tide was out, and saw ten [or] a dozen grilse, not exactly broiling in the sun, [but] they were very dead, and high and dry, havi[ng] been caught in the fixed engines to wh[ich] reference had been made in the paper. Th[ey] were killing the goose that laid the golden eg[gs] in most of the rivers in Scotland and Ireland, [as] well as in the few salmon rivers in England. T[he] point he should be inclined to lay most str[ess] upon was the restriction if not the absol[ute] prohibition of netting in fresh water; in ma[ny] rivers it was looked upon as intolerable a[nd] forbidden, but in some it was still allow[ed] above the tidal flow. On this point he spo[ke] rather as an angler than as a citizen anxio[us] for the food supply of the people, but unl[ess] the assistance of the upper proprietors was secur[ed] to preserve the fish on the spawning-ground the[re] would soon be no fish to spawn. The upp[er] and lower proprietors must work together, if a[ny] good was to be done; and that could only [be] achieved by allowing the salmon to go freely [up] to the spawning beds; and by the upper proprieto[rs] seeing that the beds were preserved and t[he] stock kept up. They complained of Gover[n]ments being so inert in this matter. Th[e] reason was that M.P.'s took no interest in [...]

that was because their electors did not e them to do so, but he hoped the time would ne when the Government would be compelled to some little attention, not only to art, science, l literature, in a manner they had never done ore, but to such matters as fresh water and sea eries. One could not but be struck with the raordinary efforts made by the Governments of the ited States and Canada to increase the production fish food for the people, but it must be re- mbered that there were several reasons in those intries. Not only were they younger and more husiastic, but the United States had two coast es separated by an enormous tract of inland intry, and many important towns and cities were ndreds of miles from any source of fish supply. is led to the cultivation of fish, and liberal grants re made for State hatcheries. We might come to t some day, but whether the artificial hatching of mon would be a success was a matter on which we l no certain knowledge as yet.

Mr. C. E. FRYER said he had known Mr. Willis nd officially for the last 30 years. His own position, Inspector of Fisheries, and the existence of the Royal mmission, would preclude his going, in any detail, o many of the points raised, and he noticed that Mr. illis Bund himself rather put forward points for con- eration than expressed any definite opinion of his n, though no one was better entitled to do so. ith regard to fixed engines and their effect he ist have a great deal of knowledge, and he uld venture to suggest to him that the restric- ns which he proposed on netting in fresh water ght also be applied with advantage to engines, ere fixed or movable, in narrow estuaries. As to e possibility of placing further restrictions on the e of nets generally, he might remark that the power Boards of Conservators to restrict the length of ts was limited; there was no power to limit the igth of a hang net, nor of a draught net below o yards. This point would doubtless be considered the Royal Commission, and it was very desirable at the views of gentlemen of experience should be iced before them. With regard to such questions the pollution of rivers and the abstraction of water m them, he sympathised very warmly with what d been said, in fact some twelve years ago or more e of his annual reports was devoted almost ex- isively to the question of the pollution of rivers, d the means to be adopted to prevent it, and a year two later another report dealt almost entirely th the question of the abstraction of water for wn supplies. Since then the Department had id considerable attention to both these matters. e did not think Boards and Conservators neglected eir powers, but they did not possess sufficient, and, the Chairman had suggested, it was for the public bring pressure to bear on the Legislature in order at further powers should be given. He might say that not a single measure was introduced into Parliament with the view of abstracting water from a river, which was not subjected to minute criticism by the Board of Trade, and, where possible, clauses were introduced for the protection of the fisheries. The results, though not very conspicuous, were all in the right direction.

Mr. RUTHERFORD asked how the statistics as to the decline in the catch of salmon in the Severn were arrived at, and if they were absolutely trustworthy.

Mr. G. H. HARDY said he should like to add his testimony to the importance of the question of the abstraction of water. There was no doubt that the disafforestation of the country had changed the character of the rivers, and there was more loss of salmon from want of water than from any other cause. This led to a deposit of mud, which choked and killed the eggs, and the production of salmon must depend on propagation. In spite of the number of problems still unsolved, they were getting to know something about salmon hatching which would supply a clue to future legislation. If a sufficient number of smolts were sent into a river, some would return; at present the number depended on what were naturally hatched, which number was very small, and was getting smaller. The number, however, which could be reared with a trifling quantity of water was remarkable if precautions were taken that the water was preserved for the salmon and nothing else. With a mere mountain stream, if you exterminated all the small fish, even the common brook trout, you could hatch not thousands but millions, and prepare the smolts for the sea; and that would be an artificial hatchery on some scale; and something of that kind would be necessary when the abstraction of water was carried much further. There was plenty of water, if it was kept for the salmon, and not for its natural inhabitants who competed with the salmon for the food. You might as well expect to rear sheep in a rabbit warren, as to make large hatcheries where the water was practically monopolised by competitors for the natural food in the water, though that food was present in enormous quantity. A mere tank of water would provide food for a very large number of small trout, without any artificial food whatever. An artificially reared smolt, which had been used to two meals a day of grated bullock's liver, was not a good fish to turn into a river, but if they were reared naturally in a mountain stream devoted to them, he believed they could put into many streams salmon smolts in numbers as large as in times past, when the returns from salmon were very considerable. There would have to be national hatcheries because the expenditure incurred would be great and the returns would be reaped in distant localities. There was no reason to suppose that a salmon hatched in a certain

river returned to that river, that was mere conjecture founded on the analogy of birds, which must be misleading. If some such scheme were initiated salmon legislation might be enlarged, and would be for the benefit of both the angler and the net fisherman, and the public food supply would be increased. In fact if a sufficient number of salmon ova were hatched there need be no close time enforced for netting.

Mr. F. G. AFLALO said he knew very little about salmon legislation before, but had learned a great deal that evening. The Chairman said that if the netting at the lower end of the river were stopped or restricted they might rely on the upper proprietors doing all that was required to keep up the supply, but his experience hardly coincided with that opinion. He knew a salmon river near Christchurch, where he often watched the men netting, and when he ventured to hint that they were sweeping the river and giving the fish no chance, they replied that if they could not catch them there they would only be netted by the proprietors whose names they mentioned higher up. He suggested that such a thing was impossible, that the gentlemen referred to were too good sportsmen; but he made further inquiries, and was afraid that every salmon which the poor fishermen at Christchurch let slip was not only netted further up, but was sold in Bournemouth by the dealers. If then, they were going to prevent the netsmen getting the salmon at the mouth of the river, simply to let the rich landed proprietors higher up net them, he did not think robbing Peter to pay Paul was a strong enough phrase to apply to it.

Mr. S. H. COWPER COLES said, as a Conservator of the Usk and Wye Board, he could support Mr. Willis Bund's figures as to the decrease of salmon in the Severn, and might congratulate him that they were no worse. On the Wye, where they had not very good statistics, and on the Usk, where they were carefully taken, the decrease had been much greater.

Mr. WILLIS BUND, in reply, said he could not state exactly how he got his statistics, or probably he should get no more, but they were obtained partly from water bailiffs who kept an exact account of fish caught, and partly from other sources, which he believed were trustworthy. He was quite certain that the numbers stated had been caught, and believed the figures were rather under the mark than over. With regard to fresh water nets, he had to confess that he owned some himself, but they were not very profitable, and he should be only too glad to see netting in fresh water abolished. He believed if fresh water nets were properly worked, you could take every salmon out of a particular hole, and that was why he suggested that only one draught should be allowed in so many hours. You knew a fish was there, and if you did not catch him the time, you went on till you did—at least that was practice on the Severn. He thought you ought t content with one try. He quite agreed with what Fryer said about the action of the Board of Tra thanks, in great measure, to him—with regar various water schemes, but the mere fact of Board calling attention to the schemes did not the case. It only gave the Conservators notice they must have a fight in Parliament, and, as few Boards had money enough for their ordi expenses, if they went in for a fight it was at sacrifice of other work. Of course, if it was a question they must do it, but it entailed a los other directions. A certain line ought to be down, beyond which a corporation should not and he might add that the present not about compensation were altogether inadeq The Liverpool people gave the Severn 13,000 gallons a day, and four days a month 50,000 gallons, but when you got three parts of way down the Severn you could not trace the ef even of the 63 million gallons. Yet they were tre more liberally than any other river in the cou The question of nets in narrow estuaries was which required to be very carefully dealt with. knew a case where one net practically swept the est clean; but there must be a certain amount of sal caught, and that caught in the estuary was the l He agreed to a great extent with Mr. Hardy, bu wanted to go a great deal farther than he had vent to suggest. If you could trust the Fishery Bo he should be in favour of giving them large powe netting and taking out fish, and it was quite true you could not do any good in the way of rea salmon unless you first prepared the river. But was to do it? The Boards had no power to put into a river, and he did not think Parliament w give them the power; in fact, he should be sorry t some of them entrusted with such a power. Prob the greatest poachers would be the Boards themse The feeling between landowners and the Boards not what it might be, and under the present m of election it would be a source of continual bit ness. It was quite true you could not have sal and coarse fish in the same stream, and he sh like to say you should have salmon only; but he not think it would be any use at present asking Pa ment to give Fishery Boards power to net private perty. He quite agreed that the young salmon mus accustomed to get their own living. When yo fry were turned out into a river, a large propor either died or were eaten. He also concurred in view that the flow of the rivers was largely affecte the drainage of the land; it was a constant abst tion of water on a small scale, similar to that w went on for the town supplies on a large scale.

The CHAIRMAN then put the motion for a of thanks to the reader of the paper, which carried unanimously, and the meeting adjourned.

Miscellaneous.

ALUMINIUM IN INDIA.

Mr. Alfred Chatterton, officer in charge of the uminium Department, School of Arts, Madras, s lately reported on the condition of the industry India.

Two years have now elapsed since the aluminium lustry was started in the Metal Work Department the Madras School of Art as an experiment in the hnical education of the Indian artisan classes. e metal has now been in use in India for a ficiently long time for the people of the country to ve had ample opportunity of testing its merits and covering its defects, and the fact that in the ginning the demand was very small, but has, ough the whole period, gone on steadily increasing, sufficient proof that there is an important field in ich it finds useful employment. To define the its of that field would be rather difficult, as, on the e hand, it is being used in the form of certain oys as a substitute for a cheap and common metal e cast iron, whilst on the other it is largely taking e place of silver for certain vessels which are to be nd in the houses of most wealthy Hindus. The im originally put forward that it was *facile princeps* e best material known for the manufacture of oking pots of all kinds has been thoroughly established after exhaustive trials—by military officers in ntier manœuvres, where lightness is a great advange and ability to stand a good deal of rough usage ential; by clubs and regimental messes where, it y be assumed, the higher flights of the culinary receive attention; by private individuals whose in requirements are durability, cleanliness, and edom from all risk of poisonous compounds; and hundreds of natives of this country who find that en it is given a fair trial it is found to possess many vantages over the metals they have hitherto been stomed to employ. Among Europeans its use will mainly confined to the kitchen and the camp, but ong Hindus its range of utility is much greater, d it is merely a question of time before it practily supersedes the use of brass and copper. There very little prejudice against it, and its properties ly require to become known and believed in for e use to spread with great rapidity. The market en to the manufacturers of aluminium wares is so ormous that every additional source of supply is new source of enlightenment to the people, with e result that business all round increases, and the w-comers, instead of proving rivals to, are unubtedly assisting the efforts of those who have en longer in the trade. During the last twelve ars the average weight of copper imported into adras every year was 209 tons, and of brass or llow metal 1,141 tons. In 1899, on account of the rise in price of these metals, only 7 tons of copper and 308 tons of yellow metal were imported. Of aluminium, since the industry was started in April, 1898, 111 tons have been imported, of which, however, a considerable quantity yet remains unsold. At the present time, volume for volume, aluminium sheets are only two-thirds the price of copper sheets, and are exactly the same price as brass sheets. Ingot metal and the No. 6 alloy, which is largely used for castings, are much cheaper than brass. That the selling price of aluminium goods is still higher than that of brass, and about the same as that of copper, is simply due to the initial expenses in establishing a new trade, and to the difficulties which occur in the processes of manufacture, owing to the absence of a reliable solder which can be easily worked. All aluminium vessels, except those of very large dimensions, are made out of sheets by hammering up, or are cast, in both cases without points or seams of any kind. The only exception to this is when thin sheet aluminium is used in place of tin plate, and then lapped points are made. For simple shapes these are perfectly satisfactory, and in practical use have proved very durable, as they are not liable to rust. This branch of the business is becoming of considerable importance.

The very high prices at which the other metals are now sold has, so far, had very little influence on the aluminium trade, as the stocks in the country are enormous; but in the hands of the dealers they are now nearly exhausted and the prices of new vessels must soon rise. It is then anticipated that this will very materially assist aluminium to make its way into public favour. It would be very unsafe to predict that prices will not again fall to their old level, but the chances are decidedly against it. All over the world the consumption of copper for electrical purposes is rapidly increasing, and the sources of supply, though very large, are limited, and it would seem probable that in the future aluminium is likely to be less affected by fluctuations in value than copper. There is abundance of raw material, and as the demand increases new works will be established to extract the metal. This is a purely industrial operation that is not subject to the periodical vicissitudes of all mining enterprises.

Turning to the work of the Aluminium Department of the School of Arts during the year, it will probably be easiest to show the progress made by the following statement of the weights of metal which it has been necessary to purchase each quarter since work was first started:—

1898-99.	Weight of Aluminium purchased in lbs.
1st Quarter	4,321
2nd ,,	4,541
3rd ,,	5,263
4th ,,	5,977
Total	20,102

1899-1900.

1st Quarter	5,992
2nd ,,	11,094
3rd ,,	17,660
4th ,,	20,869
Total	56,615

In 1898-9 the sales at the School amounted to Rs. 51,816-10-6 and the profit to about Rs. 8,000, whilst in 1899-1900 the sales were Rs. 1,10,657-10-5 and the profit Rs. 13,704,6-3. Roughly, three times the quantity of metal was actually worked up and sold for twice the money, showing that extended experience and a larger scale of working has enabled us to effect a very considerable reduction in the cost of production. A small amount of work was done for the Government of India in the Military Department and a large amount for individual regiments. This means that, so far, the use of aluminium has not been introduced into British regiments who are supplied through the Commissariat Department, but that it has been extensively availed of by native regiments, who provide their own cooking pots. A number of officers' messes in British regiments have been supplied, and altogether over 50 British and native regiments have made use of the facilities for producing their special requirements which have been established in Madras. The bulk of the local trade is probably in the hands of the local firms and the greater part of the business done by the School of Arts was with other Provinces of India, especially the Punjab, the North-West Provinces and Burma. That this will continue for long is hardly to be expected, as once a steady demand is created the industry is almost certain to be started in the locality whence the demand arises for the freight on bulky vessels, from one end of India to another, adds very materially to their cost.

In concluding his report Mr. Chatterton says it is only fair to the public to point out what defects have been brought to our knowledge. We find that salt by itself has practically no action on the metal; neither have the ordinary organic acids which occur in foods, but the two in combination undoubtedly cause the metal to corrode, and it is therefore inadvisable to allow such condiments as salted or pickled limes to stand for any length of time in aluminium vessels. A few cases have also come to light where water has apparently produced a very slight chemical action on the metal, leading to the appearance of white spots of hydrated oxide of aluminium. The compound is perfectly harmless and quite insoluble, but the cause of its production is still obscure. Probably, in most cases it is due to galvanic action owing to the presence of another metal in contact with the pot and in others to variations in the hardness of the metal. A good scouring with sand generally cures the defect, but in a very few instances this has not proved effective and it is then probable that some accidental impurity has got into the metal in the course of manufacture.

MANUFACTURE OF CARAMEL.

The following abstract of a paper by Mr. Gordon Salamon and Mr. E. N. Goldie, read a recent meeting of the London section of the Soc of Chemical Industry, is quoted from the *Brew Journal*:—

The object of the investigation was to clear certain questions connected with the manufactur caramel from glucose. The two essential sell features of caramel are maximum colour intensit ratio to density, and non-deposition in the liquid is intended to colour. All stages of the change the conversion of glucose into caramel were caref studied in the factory by the authors, and it found that the temperature from the time at wh the glucose melts to the formation of colour materially lower than when cane sugar was emplo as the starting material. The finished product fr each source was shown to be substantially the sa with respect to its behaviour towards reagents, a it was urged that for technical purposes, at events, the two might be regarded as identical.

An exhaustive sketch was given of the chemistr caramel, the works of Gelis, Peligot, Pohl, and ot being discussed. The scanty technical literature also dealt with, and in this connection cert processes were described which had been introdu into England from the Continent, where some y ago they had been worked secretly. These consis exclusively in the use of ammonium carbonate, pot and soda. The analytical data requisite in order judge the merits of a caramel were fully discuss and in the opinion of the authors these consisted the determination of the colour intensity in terms a given standard, the density, the mineral mat the cupric oxide reducing power and the behavi towards proof spirit. The action of citric and tart acids on a solution of caramel was stated to b valuable test. A good caramel should, of course, unfermentable, and the authors showed that might be controlled analytically by fixing a defi maximum limit of cupric oxide reducing power.

Ordinary commercial samples of caramel w treated with absolute alcohol, whereby they w separated into a soluble and insoluble portion. Th portions were isolated, dissolved in water, and colour intensity for a solution of definite gravity, well as the cupric oxide reducing power determi in each case, with the result that the portion solu in absolute alcohol was found to have very li colour intensity indeed, but much the same cu oxide reducing power as that insoluble in absol alcohol, to which the colour intensity of the sampl practically due. It is interesting to note that ratio of substance soluble to substance insoluble absolute alcohol in a well-made caramel is found be on an average 15 : 85. The desideratum of caramel manufacturers is therefore to obtain a cara of maximum colour intensity, the colouring princi of which are permanently soluble to as high a deg as possible in alcohol of a strength between

its of proof spirit on the one hand and absolute ohol on the other. Glucose heated *per se* not produce an intense caramel, but the sence of ammonium carbonate and potash or a are essential. The authors devoted much ntion to the elucidation of an important point from aanufacturing point of view, namely, what sub- ices other than those just mentioned could be used making caramel from glucose so that the results ght be the same or better. They found that a at improvement was effected both as regards our intensity and non-precipitability in proof spirit employing in the manufacture two parts of monium carbonate, and one part of ammonium oride. Amongst the many substances tried were ordinary mineral acids and the better known anic acids. Acetic acid was found to give un- tain results as regards colour intensity; in many tances, however, this was high, and, generally speak- , the flavour was pleasant. Tartaric and citric acid e intensity of colour, but this was accompanied by sh flavour. Potassium and sodium salts gave unsatis- tory results, in that, as a rule, a precipitate occurred beer coloured with the caramel made by their use. the various ammonium salts tried, ammonium trate gave the best results, ammonium acetate e results which could be described as good, whilst monium sulphate gave fair colour intensity, but idedly harsh flavour. The maximum and minimum antities to be employed of some 20 or 30 salts was ermined, and in each case the qualities of the ious products obtained were ascertained by the termination of the factors already mentioned. It s shown that by the addition of caustic alkalis at final stage in the production of caramel, colour ensity could be increased, and the tendency to posit from a solution annulled. The quality and neral character of the caramel was proved to pend enormously on those of the glucose used. It s found that a well-made maize-glucose, containing igh percentage of dextrose, might by appropriate atment be made to yield caramel of the best quality.

PRODUCTION OF IPECACUANHA.

One of the most widely used of all vegetable drugs the powerful emetic ipecacuanha, which is obtained m a Brazilian shrub. The French Conseiller de mmerce, at Cuyaba, in the State of Matto Grosso, azil, gives in a recent report an interesting account this plant, which has in that State and the neigh- uring districts its only habitat. The drug is tained from plants which attain a height of from to 16 inches. The leaves are oval, dark green, d sharply ribbed, and the white flowers give place an ovoid fruit containing black seeds. Besides the *ecacuanha Cephoelis*, or the "white ipecacuanha," it is generally known, there are several other rieties which are somewhat different, but all are ed for the same purpose, and are distinguished as own, black, and striated ipecacuanha. The drug is obtained from the root of the plant, where it occurs in quantities about the size of a quill, between the layers. The taste is acrid and bitter, and the odour is nauseating. That found next to the bark is most active in its effects, having in the highest degree the emetic property, due to the active principle known as "Emetine." The State of Matto Grosso which, as before observed, is the habitat of the plant, is one of the richest in Brazil, among its many natural products being gold and diamonds, rubber, sarsaparilla, jalap, jaborandi, copaiba, various gums and drugs of several kinds. Ipecacuanha is found in the north and north-west of the San Luiz-de-Caceres, formerly in the Villa Maria region, and its habitat covers an immense area comprised between a network of rivers in Brazil, Bolivia, and Paraguay. The dense foliage of the forests of this region provide the dank and humid conditions which favour the growth of the shrub. The Brazilian product is known as Rio Ipecacuanha, and the product secured from similar shrubs in other countries passes under the name of the port from which it is shipped. Attempts have been made to transplant the shrub and to cultivate it in British colonies in various parts of the world, but without success, and Brazil continues to be the only source of supply for the best grade. The process of gathering the plant is perfectly simple, and during the rainy season, while the ground is soft, is very easy. A stick is inserted under the root, and while this is raised with one hand the entire plant is pulled out with the other. As little care is given to the protection of enough plants to secure a future supply, the output is growing smaller, and the price consequently higher each year. The scarcity of workmen is a great difficulty. In the dry season the roots cannot be gathered, and it is at this season when any one adapted to the work is engaged in gathering rubber. During the rainy season, from October to April, when the plants may be easily drawn from the ground, women are usually employed for the work.

Correspondence.

CULTIVATION OF INDIGO.

I promised a short time ago to communicate to the Society any information I could gain as to the cultivation of indigo in India, and now beg to quote on the subject a letter from one of the Deputy Collectors in Gujarát.

Indigo cultivation is now carried out in the Tálúka of Pitlád, belonging to H.H. the Gaikvár of Baroda, and in Vásna, a Cambay village, as well as in five villages in the Borsad Tálúka under the Kaira Collectorate, and in Gajera in the Jambúsar Tálúka in Broach. In this last there are about 3,000 acres, and in the former about 1,800, and the produce is apparently sufficient to meet the demand in the Surat, Broach, and Kaira Collectorates. The cultivation

and preparation of the dye in Gajera are described as follows:—

Seed is sown after the first good fall of rain. When the plants are sufficiently high weeding and harrowing take place. When the plants mature in September, they are cut and brought in in carts to masonry vats near a well. They come in in the morning and are kept on the ground in an upright position; in the evening they are placed in a vat and pressed down with heavy pieces of wood. Water is then let in from another vat just sufficiently to cover the wood. On the following morning the plants are taken out, each handful being previously washed in the water as it is taken out. Six men then get into the vat and for three hours work it about with their feet, after which the water is allowed to stand till evening to clear, the colouring matter settling down, and the clear water is drawn off through a hole in the vat. The colouring matter left is then taken out and put into a small masonry vat close by, where it is allowed to settle for another night, after which the clear water at the top is again drawn off. The thick deposit is then spread over a coarse, thick cloth, in a pit about 5 feet long and 4 broad, and there allowed to dry till the next day, when small quantities of it are placed in rows on ashes spread on the ground. The ashes draw out the water from the colouring material, and are first passed through a fine sieve. On the lumps becoming sufficiently dry they are removed in bags, and presumably sold in this state. The large vats, of which there are two at each well, are about 4 feet in depth and 12 feet in length and breadth, and the one small vat is about 2 feet deep and 4 feet square.

The stumps of the plants are left in the ground for another season, and grow for the second year; but their yield is smaller than in the first. I have not been informed of what the produce per acre is, or at what rate it is sold, but it certainly would be increased by the use of proper crushing machinery. I wil ascertain what the yield is as well as the price the dye fetches.

A. ROGERS.

Obituary.

JAMES M. GARRARD.—Mr. J. M. Garrard, the senior partner of the eminent firm of Garrard and Co., who died on March 3rd last, was a member of the Society of Arts since 1895. The Swiney cup was made by his firm, from the designs of Daniel Maclise, R.A., and when, in 1894, a prize was offered by the Council for a new design, Mr. Garrard assisted the committee with his valuable advice. Mr. Garrard was born on December 26th, 1834, and was apprenticed to the firm of R. and S. Garrard and Co. in the year 1849. Through life he was distinguished by his practical knowledge of the trade, and by his keen appreciation of good workmanship, and of the artistic side of his professi[on]. He was esteemed a specially expert judge of anti[que] plate. In 1896-97, he was Prime Warden of [the] Worshipful Company of Goldsmiths, and on [the] establishment of the Nicholson Charity, in 1888, [he] was appointed one of the first Trustees by the Char[ity] Commissioners. He was also Trustee of the Go[ld]smiths' Benevolent Institution, President of t[he] Silver Trade Pension Society, and an active work[er] for most of the charities connected with the craft [of] gold and silversmiths. He was also an arbitrator [of] the London Chamber of Commerce.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at 8 o'clock:—

MAY 30.—"Russian Central Asia: Countries a[nd] Peoples." By A. R. COLQUHOUN. SPENS[ER] WILKINSON will preside.

FOREIGN AND COLONIAL SECTION.

Monday afternoon at 4.30 o'clock:—

MAY 28. — "Imperial Telegraphic Communic[a]tion." By SIR EDWARD SASSOON, Bart., M.[P.] The Right Hon. SIR HENRY H. FOWLER, G.C.S.I. M.P., will preside.

MEETINGS FOR THE ENSUING WEEK

MONDAY, MAY 28...SOCIETY OF ARTS, John-stre[et,] Adelphi, W.C., 4½ p.m. (Foreign and Coloni[al] Section.) Sir Edward Sassoon, "Imperial Tel[e]graphic Communication."

TUESDAY, MAY 29...Royal Institution, Albemarle-stree[t,] W., 3 p.m. Mr. R. Warwick Bond, "Ruski[n,] Man and Prophet."

Anthropological, 3, Hanover-square, W., 8½ p.[m.] Professor Oscar Montelius, "The Earliest Com[]munications between Italy and Scandinavia."

WEDNESDAY, MAY 30...SOCIETY OF ARTS, John-stree[t,] Adelphi, W.C., 8 p.m. Mr. A. R. Colquhou[n,] "Russian Central Asia: Countries and Peoples."

British Astronomical, Sion College, Victoria Em[]bankment, W.C.

THURSDAY, MAY 31...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Society for the Encouragement of Fine Arts, [9,] Conduit-street, W., 8 p.m. Dr. J. S. Phen[é,] "The Rise, Progress, and Decay of the Art [of] Sculpture in Greece; with the Influence of its loft[y] attainments on Modern Thought and Civilisation."

Royal Institution, Albemarle-street, W., 3 p.m. Rev. Canon Ainger, "Chaucer." (Lecture II.)

FRIDAY, JUNE 1...Royal Institution, Albemarle-street, W[.,] 8 p.m. Weekly Meeting, 9 p.m. Sir Henr[y] Roscoe, "Bunsen."

Geologists' Association, University College, W.C. 8 p.m.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square W.C., 8 p.m.

SATURDAY, JUNE 2...Royal Institution, Albemarle-street W., 3 p.m. Sir Frederick Bridge, "The Growth of Chamber Music." (Lecture II.)

Journal of the Society of Arts,

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FRIDAY, JUNE 1, 1900.

ll communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

INDIAN SECTION.

Thursday, May 24; the Right Hon. Sir rancis Henry Jeune, K.C.B., D.C.L., in ie chair. The paper read was "English riminal Procedure and the Indian Code of riminal Procedure: a Comparison." By ir John Scott, K.C.M.G., D.C.L.

The paper and a report of the discussion ill be published in a future number of the *ournal.*

OREIGN & COLONIAL SECTION.

Monday, May 28; the Right Hon. Sir enry H. Fowler, G.C.S.I., M.P., in the iair. The paper read was "Imperial Tele-aphic Communication." By Sir Edward issoon, Bart., M.P.

The paper and a report of the discussion ill be published in a future number of the *ournal.*

CONVERSAZIONE.

The Society's *Conversazione* will take place the Natural History Museum, Cromwell-ad, S.W. (by permission of the Trustees of e British Museum), on Wednesday Evening, e 20th June, from 9 to 12 p.m.

The following portions of the Museum will open:—On the Ground Floor—the Central all, British Saloon, and the Fossil and Mam-alia and Reptilia Galleries; on the First oor—the East and West Corridors.

Each member is entitled to a card for him-lf (which will not be transferable), and a rd for a lady. In addition to this, a limited mber of tickets will be sold to members of e Society, or to persons introduced by a ember, at the price of 5s. each, if purchased fore the date of the *Conversazione.* On it day the price will be raised to 7s. 6d.

These tickets will only be supplied to non-members on presentation of a letter of introduction from a member.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

Proceedings of the Society.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 30, 1900; Spencer Wilkinson in the chair.

The following candidates were proposed for election as members of the Society:—

Apcar, Apcar Alexander, 11, Russell-street, Calcutta, India.
Gladstone, Henry Neville, 4, Whitehall-court, S.W.
Hayward, F. D., 9, Gracechurch-street, E.C.
Jarman, Arthur, The University, Sydney, New South Wales.
Murti, P. N. Krishna, C.I.E., Bangalore, Mysore, India.
Nixon, Major-General John Pigot, care of Messrs. Henry S. King and Co., 45, Pall-mall, S.W.
Wood, Reginald, Fen Moor, Bottisham Lode, Cambridgeshire.

The following candidates were balloted for and duly elected members of the Society:—

Bull, Henry, 1, Queen's-gate-terrace, S.W.
Dwarkadas, Naranjee, 53, Esplanade-road, Fort, Bombay, India.
Mango, A., Messrs. Foscolo, Mango and Co., Constantinople, Turkey.
Middleton, Reginald Empson, 17, Victoria-street, Westminster, S.W.
Morris, Captain R., 3rd Bengal Cavalry, Hissar, India.
Rao, Viskvanatt Patankar Madhava, C.I.E., Bangalore, India.
Rastamji, C., Rutlam, Central India.
Wheeler, Oswald, 76, Heathwood-gardens, Old Charlton, S.E.

The Chairman, in introducing Mr. Colquhoun, said his qualifications to speak on the subject of Central Asia were unique. After spending many years in the service of the Indian Government, he made a name for himself by his journeys across the great peninsula which separated India from the Chinese Empire, a country in which of late we had learned to

take a deeper interest. After that he had a long and very interesting experience in South Africa, being the first Administrator of Mashonaland. Since then he had published a series of remarkable books, of which the first described his journey between Upper Burmah and the basin of the Yangtse. He had again visited China, and travelled extensively in the far East and in the Russian dominions, which were so rapidly increasing. He had, therefore, seen more of Asia than most Englishmen, and had enjoyed exceptional opportunities of forming an opinion on Asiatic questions, so that no doubt the paper would be of the most interesting description.

The paper read was—

RUSSIAN CENTRAL ASIA: COUNTRIES AND PEOPLES.

By Archibald R. Colquhoun.

No attempt is made, in the following paper, to deal with the political problems which arise from the presence of the Russians in Central Asia, a territory hitherto abandoned to the many tribes and peoples, some wild and uncivilised, who have inhabited the land for generations. Many of these native states were rich and prosperous, and, although Oriental, highly organised; others were mere congeries of nomad families. All present features of great interest and novelty. Of the steady progress of Russia east and southwards I have spoken elsewhere, I propose to-night to give a brief account of some of the people she has encountered in this progress and the countries which have come under her flag during the last half century. The variety of races, the differing conditions both of climate and geography which are found in these countries and peoples are not only interesting in themselves, but, when we reflect that they are already practically consolidated into well organised Russian provinces, afford an excellent illustration of the tenacity of purpose characteristic of the Slav race, and also of their power of assimilation. Their success in this direction must be largely attributed to the fact that they are themselves partly Oriental, and so akin to the people they have conquered.

The territory described as Central Asia is bounded by Siberia on the north, by the Chinese Empire on the east and south-east, Afghanistan and Persia on the south, and on the west by the Caspian Sea and European Russia. It originally consisted of three kingdoms, known as the Central Asian Khanates of Bokhara, Khokand, and Khiva, of the Khirgiz Steppes, the half desert country of the Tekkés, the oasis of Merv, a the districts of Kuldja, Ferghana, Zarafsha and the Pamirs. These are now, roughly spea ing, divided into the provinces of Orenbur in the north (including a large slice Siberia), Turkestan and East Turkestan cent and east, and Transcaspia on the we Bokhara retains its native ruler and form government, but is under Russian suzerainty

The climate of Central Asia varies co siderably from north to south, and m be roughly divided into three zones. T northern zone extends as far south as latitu 45°, and includes the lower course of the S Daria to Fort No. 2, and the lower cou of the Ili. The climate in this zone is wh is known as "continental," with very h summers and very cold winters. Snow r mains on the ground for about three mont while the summer is extremely hot, and la from four to five months. The central zo includes the towns of Perovsky, Turkest Aulieata, and Vierny, with the middle cou of the Syr Daria and a large portion of t Kyzyl Kum sands. Here the winter may compared to that of Central Germany, wh at Vierny grapes ripen, though not so w as further south. The southern zone is tro cal, and includes Kuldja, besides those tow which lie either in the same latitude or so of Tashkent. Kuldja owes its comparativ high temperature to its sheltered positi being surrounded by high mountains, whi protect it from the north-easterly winds prevalent in the rest of the central zo Fruits of a delicate nature flourish—peach apricots, pomegranates, and grapes. T winter, though cold, is short, snow seld remaining on the ground for longer than month. There is, however, a great deal rain, the rainy season lasting from about Mar till October.

The district of Hodjent, acquired by Rus in 1874, lies south of Tashkent, and w the valley of Zarafshan is the most fert part of Central Asia, and was for some ti a disputed point between Bokhara and Kh kand. The country here is better wood than most parts of Central Asia, and a better watered; everywhere one sees the bea tiful gardens which are the joy and pride all dwellers in Central Asian towns. Th gardens surround most of the cities, and often used as summer residences, the Russia even having adopted the fashion, and campi out in roomy tents and pavilions during t hot months. Peach, cherry, and apple tr

ke these gardens beautiful, and it is much e regretted that, owing to the scarcity of l, these orchards are being largely cut n for fuel.

Vith regard to mineral produce, the lack of d coal in Central Asia is likely to prove a ous drawback to its development, although improvement in communications will largely edy the defect. Since the acquisition of kestan, the Government have made great rts to discover really productive coal-beds; although coal exists scattered pretty widely Central Asia, all that has been obtained erto is of inferior quality, and broken up small fields. As for other minerals, it is ous, considering the trifling amount of l found in this part of Russia's new sessions, to remember that her first towards Asia was initiated by Peter Great because he had heard so much the gold to be found on the banks of Oxus. Lead-ore is the most abundant eral, but this cannot be mined with any t profit on account of the dearness of fuel difficulty of transport.

here are several different races inhabiting tral Asia, but, broadly speaking, they are f Persian or Turkish descent. A part of country was undoubtedly inhabited in early s by the Sacæ, or Scythians, an Aryan who were, to a large extent, dispossessed driven out by the Turkish tribes who over- the country. The descendants of this ient race are still found in considerable bers, often clustered together in mountain ges, to which they have been gradually en by the succeeding waves of Russian sion. A curious testimony to the antiquity he race is the fact that their language ins many words of Aryan derivation which not known in modern Persian. The jiks, as they are called, are distinguished, only in appearance, but in character, from tribes of Turkish descent. The typical jik is large, thickly bearded, vain with the lish vanity common in primitive races, untruthful, and morally corrupt. He ises his less subtle Uzbek neighbour, who ns the sentiment, but is nevertheless com- d to make use of the sharper wit of the jik. The Uzbeks, who form a large pro- on of the population in Central Asia, are ibe, or congeries of tribes, of much the origin as the Kirghiz, being founded by ish immigrants who flocked into the try both before and after the time of ghiz Khan. Unlike the Kirghiz, however, the Uzbeks have little of the Mongol element. They speak a Turkic dialect, and retain, at all events traditionally, their old division into clans or families, the names of which in some cases perpetuate long-forgotten tribes. One clan is that of the Kiptchaks, whose martial habits and traditions made them a chief factor in the army of Khokand. The most numerous race, in the western part of Central Asia at all events, is the Kirghiz, also perhaps the most interesting.

This tribe really consists of two distinct races. The true one, the *Kara* or "Black Kirghiz," is found principally in the valleys of the Thian-Shan and Altai Mountains, and is unmistakably of Turkish origin. Descriptions found in Chinese writings of a very early date show that at that time the prevailing type was characterised by light hair and fair skin, which would not apply to the average Kirghiz of the present day, although such may still be met with here and there,

The other race, which inhabits the greater part of the province of Turkestan and the steppes bordering it, called by the Russians "Kassak-Kirghiz," is more impregnated with the Mongol element than the Kara-Kirghiz. They have largely intermarried with the Kalmuks, and their aristocracy, or "white bones," claim descent from Genghiz Khan, while their various traditions describe them as being descended from a "red-haired dog," or (a more poetical story) as veritable "Children of the Mist." Both legends suggest the great antiquity of the race, as is usual with aboriginal tribes of undoubted pre-historic origin, both in America and Australia. The claim of descent from an animal is found with other Asiatic tribes, and is always supposed to denote considerable age.

Although he has now lost his independence, the Kirghiz still retains many curious and characteristic traits, one of these being an incurable contempt for a settled or town life. "Sart," the term applied to merchants and townsfolk, is used contemptuously, and would be much resented by a true Kirghiz, who has a scoffing proverb to the effect that "when a Sart becomes rich he builds a house, a Kirghiz buys more wives." When on the move they live in *kibitkas*, or field tents, stretched on light wooden frames, and resembling the Mongolian *yourtas*. These *kibitkas* are exceedingly portable, and can be packed for a journey in less than an hour. The Kirghiz, as a rule, are of swarthy complexion, and are short and sturdy in build, the men shaving the head, but

allowing the beard to grow, while the women wind yards of cotton stuff about their heads. The male attire consists usually of a pair of baggy leather breeches, a coarse shirt, and one or more rough coats, the head being covered with a skull-cap and a conical hood of sheepskin or felt. On special occasions a red velvet coat and a tall felt hat, with turned-up brim, are worn by the well-to-do. Polygamy was adopted by the race at the time when the Russians forced Mohammedanism upon them, and the position of their women folk is not enviable. When a man wishes to marry he buys a wife, or one is bought for him by his relations, and once the *kalym*, or purchase-money, is paid, the wife becomes the mere chattel of her husband, who generally treats her with less consideration than he does his cattle. He can divorce her with the greatest ease, and her family may then attempt to sell her again. However much she may be ill-treated she has no redress, the utmost that can happen being a remonstrance from her relations to the husband for "depreciating her market value;" whilst even if he killed her, under Kirghiz law he had no more serious penalty to encounter than a fine. "A woman has only half as much soul as a man," says a Kirghiz proverb; and the men of the tribe evidently act up to this belief. The more serious crimes are now amenable to Russian law, but smaller matters are settled before certain chosen elders, who are not paid for their services, but receive a portion of every fine they inflict. Hitherto little has been done by Russia to civilise the tribes under her dominion, and such a thing as a Kirghiz school is practically unknown. Although Mohammedanism is nominally their religion, the Kirghiz do not trouble much about doctrine, many of them still adhering to the old *Shaman*, or devil-worship, while ancestor-worship is still largely practised.

It may be said, perhaps, that the principal object of Kirghiz existence is the breeding of cattle and horses, to which nearly the whole of their time is devoted. In bartering his cattle the Kirghiz does not make a feature of honesty, and will invariably cheat whenever he gets the chance.

Fond as he is of horse-flesh, his sheep—of which he has a famous fat-tailed breed called the *Kurdiak*—are perhaps nearest to the heart of the Kirghiz. All over Central Asia and in Southern Siberia mutton is the staple food, and the nomads who inhabit the steppe regions are accustomed to eat it in tremendous quantities. The allowance for a Mongol driver [of] a caravan, for instance, is a leg of mutton p[er] man per day; but it must be added that shou[ld] meat fail, the Mongol is not only capable [of] foregoing his favourite food, but of existing [on] fare so coarse and scanty that no Europe[an] could support life on it. The nomads, as [a] rule, do not take much trouble over the p[re]paration of their food, boiling it in a pot, a[nd] taking it out in handfuls as it seems to th[em] sufficiently cooked, or gnawing the flesh fr[om] the bones, which they return to the pot aga[in]. A very delicate dish, and one set bef[ore] honoured guests, is composed of the tails [of] sheep; and the shin-bone of this useful anim[al] is carried by superstitious Kirghiz as [an] amulet, and is also used in divination. Th[e] sheep are, indeed, so important to the Kirg[hiz] or Uzbek, or to any native of Central As[ia], that it is etiquette to suppose, for the sake [of] courtesy, that every man possesses flocks, a[nd] in greeting him the first inquiry must be [not] for *his* health but for *theirs*.

The favourite drink of the Kirghiz is m[ade] from brick-tea, but *kumis*, or mares' milk, [is] drunk, as among the Mongols, to prod[uce] intoxication, for which purpose also is use[d a] kind of beer, distilled from grain, called *bu*[*za*], which has a stupefying effect.

On the whole the Kirghiz are a sim[ple] and credulous people, not particularly bra[ve]. Owing to their skill as trackers, in which t[hey] rival the Red Indians, they make excel[lent] scouts.

The Kalmuks, with whom, as has been s[aid], the Kirghiz have largely intermarried, [are] another race of Central Asian nomads, [and] originated in a confederacy of Mongol tr[ibes] living in Zungaria, on the north-western bor[der] of the Chinese Empire, and combining toge[ther] to resist the aggressions of another trib[e of] kindred origin. This confederacy, know[n as] the Oirat, made attacks on China, and at [one] time took the Emperor prisoner, and marc[hed] to the walls of Peking. Internal dissensi[ons], however, broke the power of the Oirat, [and] some of the tribes migrated to Siberia, prob[ably] receiving at that time the name of "Kalmu[ks]," which in Turkic dialect means "remna[nt]." Zungaria still remained in the possessio[n of] the same tribes, whose fratricidal wars [and] quarrels finally ended in their becoming va[ssals] to China. Meanwhile, the Kalmuks had [been] driven further and further, till finally [they] crossed the Ural, and settled in the l[ower] region of the Volga. Finding her new sub[jects] in Zungaria inclined to rebel, China to[ok]

:t way of quieting them by a wholesale ;sacre, and as the country was left desolate, ards the middle of the 18th century, military nies of Manchus were formed and Chinese iinals sent, while large numbers of agricul- sts were deported from Eastern Turkestan. last-named became known as *tarantchis*, occupied a position analogous to that of sian crown peasants. Although Moham- ans, they lived among their Buddhist hbours quite amicably, and the only rence made by the preponderance of the iese element was in the unveiling of their ien. Another element was added in 1771, n the Kalmuks, hearing that their mother- itry had been depopulated, returned *en se*, taking eight months on the journey, suffering much both from want and the cks of the Kirghiz. When they arrived found the country occupied by the iese, and having no alternative, except to into the hands of Kirghiz or Russians, they ed down on the pasture lands, became ect to the Chinese, and devoted themselves he breeding of cattle and horses. The nuks are all Buddhists, and are completely golian in type and customs. This district, vn, from the name of the Manchu settle- t which dominated it, as Kuldja, was exed by Russia, but returned to China on ulfilling certain conditions.

1 the western side of Central Asia there nany different families or tribes of Turko- s, who are somewhat similar in habits to the hiz, although some, like the Tekkés, live y in villages and are agriculturists. No offered more stubborn resistance to the sians than the Tekkés, and none suffered e. In the Turkoman campaigns orders given to spare neither age nor sex, and e families were slaughtered and entire icts laid waste.

most of the cities of Central Asia, besides e, are found many fragments of other s—Persians, originally brought as slaves; s, believed by some to have been the nal introducers of Mohammedanism; rews, who have been settled in the country enturies, and who have the characteristics hich their race is remarkable all over the d; Hindoos, who come and go for com- ial purposes; and also many families of es, known usually at Liuli, who lead a id life, trading in horses, while their en tell fortunes, cure the sick, and carry small traffic.

eoretically nearly all the native peoples of Central Asia profess Mohammedanism, but many of the tribes know little more of it than the name of the prophet, and some not even that. The nomads retain many practices which have no connection with Islam, and it is only in the large cities that there is any attempt at ceremonial worship. Great religious laxity prevails all over Central Asia, and the fanaticism observable among the Dervishes, who gain a living by exhibiting themselves in a religious frenzy, and even torturing themselves at times, is rather a matter of business than of true devotion.

Education among the native inhabitants is in the hands of the *mullahs* or priests, and is generally limited to such matters as have a bearing on religion or law. The foundation of colleges, where the higher religion and law are taught, has for ages been a favourite form of piety, and some still exist which were founded four and five hundred years ago. Both pupils and professors are supported from the revenues of the college, the latter receiving in addition voluntary gifts from parents of the pupils. There are also primary schools, generally attached to each mosque, and here the boys from the age of five are instructed first in the alphabet, and then in the reading of the Koran and about seven other books, which they read and copy without understanding, as they are written in Persian and Turki and never translated into the dialect of the district. To know the Koran by heart confers at once rank and sanctity on the happy accomplisher of that feat. This is usually an effort entirely of memory, as few are acquainted with Arabic, though many have read illegal translations and know the substance of what they recite. Superstition is extremely rife, especially among the nomad tribes, who attach mystic meaning to such events as the appearance of crows (as in Western Europe), magpies, and other birds and beasts. A favourite method of divination is by roasting the shin bone of a sheep and watching its appearance as it burns, from which the future is predicted by certain signs.

As regards religion, the Russians have always acted with the greatest wisdom and tolerance, never in any way interfering with the worship and practice of the conquered tribes, except that they have abolished the native functionaries whose business was to compel the performance of religious rites. Missionary projects have been by no means encouraged, although in the garrisons and in one or two towns there are Christian

churches, and a Bishop of the province of Turkestan. The Russians have acted with less wisdom in arranging the administration of their new provinces; and, in trying to force upon the natives systems foreign to their customs and characters, they have earned a certain amount of unpopularity. One instance is the method of local government by natives elected by vote, under the surveillance of the Russian Government. This, with modifications, has been tried among Kirghiz, Uzbeks, and in the chief towns. The people left to themselves would always elect men of influence and popularity—their former leaders—who, for obvious reasons, are not acceptable to the Russians, so that the system has degenerated into mere farce, and is viewed with contempt by the natives, the men chosen being merely the tools of Government.

The advent of the Russians in Central Asia has naturally made a great difference in many of the towns which, originally entirely Oriental in character and appearance, now present the curious contrast of European streets and squares, occupied by officials and their families in the unpicturesque garb of the Western world, side by side with the native towns, old, in some cases, with an age which makes such cities as York mere infants; trodden by countless generations of conquerors,—Macedonians, Scythians, Arabs, Persians, Mongols; and which have succumbed—is it for ever?—to a greater than these, a race from the West.

The further one penetrates into the heart of Asia the less has this modernising influence made itself felt; so that between Orenburg, which is really on the borders of civilisation, and Samarkand there is a wide gulf.

Perhaps one of the most typical towns under the new *régime* is Tashkent, the capital of the province of Turkestan and a city of very ancient origin. Mention is made in the 7th century by a Chinese traveller of a city, either on the same spot, or near the site of the present one.

Briefly, its history up to a certain point is the story of the struggle between the two sovereigns of Bokhara and Samarkand, and when both were subdued by the Tartar chief, Genghiz Khan, it remained in the possession of his descendants until reconquered by a Khan who ruled over both Bokhara and Samarkand. Then came the Kirghiz, who held it for more than a hundred years, till it fell before an enterprising ruler of Zungaria, and after a short time achieved a semi-independence, being alternately overlorded by Khoka and Bokhara. It was in the struggle w Khokand that General Tchernaieff, fear that Tashkent would fall into the hands the hostile Amir of Bokhara, to whom inhabitants—between Scylla and Charybdi had appealed for help, invested the city w a comparatively small army, and being tunate enough to kill the Regent of Khok in the first engagement and to cut off water supply of the city, entered by two ga simultaneously, chased the Khokandians Bokharans out of the city, and received unconditional surrender of the natives. Russian rule was firmly established, and o maintained by native police, who still s to work well under their new masters.

A Russian colony, with the Governor-Gen in his palace as the centre, and the usual m tary and civil officials and their families, now its own quarter, side by side with quaint Oriental town of Tashkent. The l houses of Russian merchants and officials whitewashed, trim, and neat; the govern palace has an ornamental garden round it, out in artificial lakes and little hills and da where a military band plays every even There are stiff public buildings, a wide squ an ugly little church, and a new impr bazaar has been erected at great cost, w has, however, entirely failed in its objec drawing the trade of the town from the na quarter, and so subjecting it more compl to Government influence. The natives did take kindly to this arrangement, and the t of Tashkent is still carried on in the old baz which has probably existed in much the s form for hundreds of years.

The bazaar is a most important featu life in all Oriental countries, and, as all baz in Central Asia have a family likeness, th Tashkent will serve as a very fair type. changes or improvements have been effect it since the Russian occupation. The st as the gate is neared, grows narrower, little shops cluster on either side; in bazaar itself it is exceedingly narrow, ro and ill-paved. A very favourite metho paving in Central Asia is by laying large bl of stone, between which are channels of in winter, and in summer of thick white Over these the Kirghiz bumps along o camel, quite unconcerned, and if the p trian does not keep carefully to the r side-walk of mud he may be knocked ov jostled by these camels. The shops are wooden huts of one or, at most, two r

ıe front of which is taken down bodily to how the interior. In the centre, on a mat, ıe seller sits cross-legged, or perhaps it is a ıanufacturer with his tools in hand. Round im are displayed his wares, and there is ttle room for his customers, who must stand utside to do their bargaining. There is one of the hurry and bustle of European hopping; the merchant displays no undue agerness to sell his goods, and the buyer is qually self-possessed and leisurely. Theoetically there are thirty-two different trade uilds, which must be represented in the azaar; practically there are more. Each uild is supposed to have thirty-two branches, nd each must have a different shop; thus, in rass-working (sometimes very beautifully one) one will make the bowl or ewer, another ıe bottom, another the lid, a fourth will solder ıem together, while at a fifth, with a sharp ıisel, the decoration is worked out. Almost very trade has its own street, the shops on ther side being devoted to shoe, or harness, or ockery-making in all their different branches.

The Kirghiz have a special quarter of their wn in the great bazaar of Tashkent, and here sold the really beautiful felt made by the omen, also coarse carpets and other articles f nomad manufacture. Here and there are rched gateways, behind which are caravanerais, some used by local merchants for storing ıeir goods, and others as hostelries for forgners. Here the merchandise lies about in iles, the camels and horses stabled around the des of the court, while overhead the merıants "live, move, and have their being," in ı atmosphere which is, luckily, peculiar to azaars.

Every Mussulman city, to be *en règle*, must ave a "Jumma," or mosque, large enough to old all the inhabitants on Fridays. Looking om the platform of the mosque in Tashkent vhence the mullah calls to prayers), one sees pparently nothing but a flat clay plain, eyond which rises a hill with another mosque, nd the domed roof of a bath. This plain is omposed of the mud roofs of the bazaar, for ıe streets are so narrow that one can only see ıem from below, and as the roofs are often vergrown with grass and poppies, this adds the illusion. The barber's shop is also the ıemist's, and here soap—very unpleasant in nell—is sold, and also the cosmetics which a ood Mussulman lady is enjoined to use in rder to preserve her beauty and so please her usband.

The natives of Tashkent are mostly Uzbeks, with a few Tadjiks, Tartars, Kirghiz, Hindoos, and others who come to trade. The population is difficult to gauge, but is probably over 120,000.

The Hindoos are the great money-lenders of Central Asia, and have their own caravanserais in most towns, but under Russian rule, unlike that of the English in India, land does not pass by sale or mortgage into their hands. The Jews are also numerous, and have enjoyed greater freedom (little though that be now) since the advent of the Russians. Formerly in many towns they were confined to a certain quarter and treated with much contempt, having very few civil or municipal rights, and being compelled to wear a girdle of common rope as a badge of their nationality.

Cotton and silk goods, of course, occupy a large portion of the bazaar, and in the booths one can see the men at work with their rough machines of wood, dexterously manipulating reels and turning spindles. The embroidery of robes is also done by men, and is in very great demand, the robe or material being stretched over a wooden hoop, the pattern roughly chalked, and the work executed with a kind of crochet-needle, with which the silken thread is pulled into a chain-stitch. There is no liquid measure in Central Asia, everything being reckoned by weight, and the standard varies in almost every town. The coins also, the most common of which is known as the *tenga*, have different values in different parts. The Russians have tried to regulate this, and are introducing their own money, which now passes current all over Central Asia.

The native houses of the better class in Tashkent, as in other Central Asian cities, have three, or at least two, courts. The first, if there are three, is used as a stable for the animals, which are accommodated in sheds round the sides. The second is the man's court, on two sides of which are the balconies of the house; while a third, frequently, has a sort of platform, used as a terrace, where the master and his friends sit to get the full benefit of the air. The house generally contains one large room, opening on the portico—the guest-chamber, with one or two smaller ones opening into it. The doors are often beautifully carved, and instead of hinges they hang on a sort of pivot let into the lintel and threshold. Windows, as a rule, there are none, but a small open space above the doors, with lattice-work let in, either open or covered with white paper, glass being still uncommon in the typical native house. The ceilings are very curious and

sometimes strikingly pretty, being composed of small round willow boughs set in between the rafters, and picked out in colours, with an occasional touch of gold. The walls are plastered and frequently painted with pictures of fruit, flowers, or small arabesques, and there are numerous niches with arched tops which act as shelves, on which are stored books, clothes, crockery, or food. There is usually very little furniture, unless the merchant has become bitten with the craze to imitate the Russians, in which case there are cheap tables and chairs of a conventional type imported from Russia, for such things are not made in Tashkent. The truly native house, however, contains little but rugs and mattresses, with perhaps a small round table, or a carved or painted wooden cupboard. The women's quarters are very much the same in arrangement and furniture, except that they may have a broad bed—the *charpoy* of India—made of a wooden frame with a network of ropes, raised a few feet from the floor. The usual bed is merely a rug or a thin mattress stretched on the ground. In many of the rooms a small basin is let into a corner of the floor, with a jug standing by, for the numerous ablutions required by the Mussulman's religion.

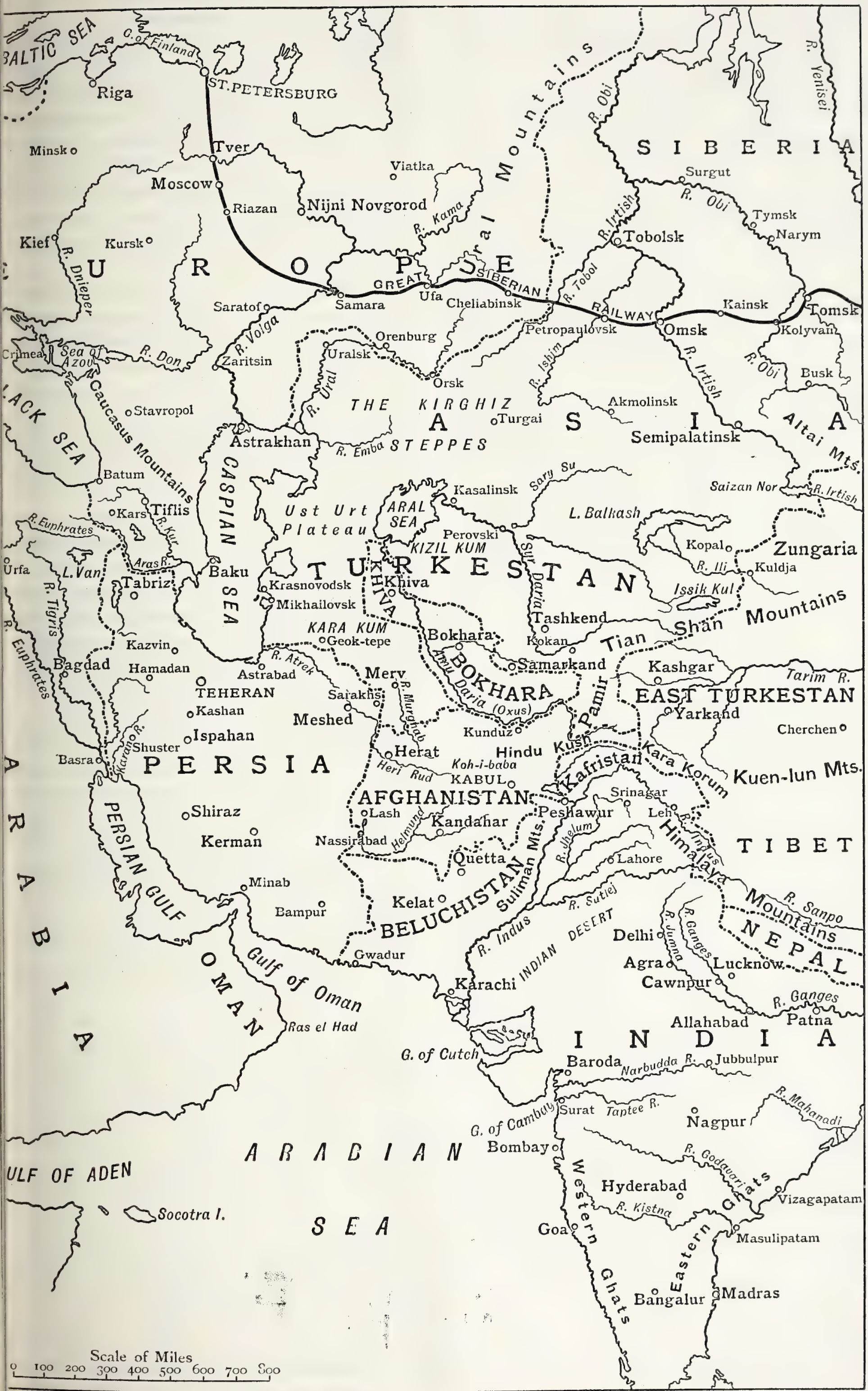
The merchant who lives in this house is attired in a pair of loose white trousers made of cotton, and tied round his waist with a cord and tassels. His shirt, also of light-coloured cotton, is very long, with a small slit for the neck, and wide sleeves; over this he wears a *tchapan*, or two or three, according to the weather. This garment is a long coat, cut very sloping at the neck, and with enormous sleeves, much too long for convenience, but satisfying the Asiatic sense of propriety, which requires that the hands be covered. The *tchapan* is of cotton or silk in summer, often striped or patterned in the most gorgeous colours; in winter one gown will be made of cloth and lined with fine sheepskin or fur. A scarf or small shawl is twisted round the waist, and a turban, either of striped cotton or, if the wearer is a *mullah* or distinguished for piety, of white material is wound round the head over a little embroidered skull cap.

The dress of the women is very similar, but their gowns are more often of silk, and many strings of beads, gold, and gems are worn round the neck, with bracelets, anklets, hair ornaments, and sometimes nose-rings. Outside they wear a thick veil of woven horsehair and a dark-blue or green cloak with long sleeves. The class of women who go abroad unveiled is such that even Jewesses and others whose religion does not demand it, canno venture out without these hideous garments This applies, however, only to the purel Mussulman cities. In the east, where th Buddhist element is strong, an unveiled woma is occasionally seen, while the custom ha never obtained among the Kirghiz and othe nomad tribes, whose Mohammedanism is eve less than skin deep.

Although there are hotels in Tashkent, an in many other Central Asian towns, they ar by no means according to Western ideas c comfort, resembling in arrangement the cara vanserai already described. The food of th country is mutton, mutton, mutton! In th town there is some attempt to vary the metho of cooking; but, as a rule, the dishes ar too greasy and insipid for European palates Wine can be got in Tashkent, imported fror Russia, at fabulous prices, but the native drin is green tea, black tea having been only intro duced by the Russians, and this is sometime thickened with cream or melted tallow, an sometimes flavoured with a small dried lemor

The walls of Tashkent are said to have bee sixteen miles round, but were largely de molished by the Russians to make barrack and parade-grounds. Outside these walls an the gardens surrounding them is the ope steppe, over which are dotted numerou villages, mostly inhabited by either Tartars c Kirghiz, the races who mingle in the cit keeping apart here. One is a sort of summe residence for the governor and his little cour and at another is a large establishment fc the breeding and improvement of horse nominally a private enterprise, but in realit subsidised by Government, which realises th importance of a plentiful supply of horses fro a strategical point of view.

Altogether, Tashkent is a curious and typic example of East meeting West. The moder Russian soldier and his Paris-dressed wife ru shoulders with the Usbek or Kirghiz, whos ancestors were Khans and Beks in this countr at a time when Russia was a mere congerie of half-savage States; or with the Mongol whose warrior kings in the days of old n only conquered Russia, but a great portion the then known world; or with the Tadjiks, almost prehistoric origin, former owners of th soil, who were dispossessed by Kirghiz an Mongol alike, but still retain their individualit All these varying peoples have accepted th yoke of their Western conquerors. Th Oriental is, above all, a fatalist, and he recog



Walker & Boutall sc.

nises the inevitable wave of Russian advance.

The Mohammedan religion, almost universal in Central Asia, gives little encouragement to those who seek pleasure and recreation, save in the exercise of religious duties and such mild excitement as learning to recite the Koran by heart. Human nature is, however, the same in the East as in the West, and the Bokharan, Khokandian, or Tashkentian, when he desires relaxation, turns to music and dancing, and even, if he is able, to horse-racing. As regards the first, the Russians of course, in such cities as Orenburg, have introduced military bands and American organs; but the purely native instruments are drums, variations of the zither and guitar, whose very names betray their relationship to the instruments familiar to us; trumpets, with perhaps one deep note, and some elementary wood instruments. The music is quite unlike our own, the intervals between the notes being less, and the notation consequently extremely varied. The effect is weird and unmelodious to the unaccustomed ear; but it is certainly more in keeping with the character and appearance of the natives than a Russian military band playing the latest opera selections. Most of the instruments, and probably much of the music, were brought from Persia, and the latter has retained its pristine rudeness of construction with a conservatism peculiar to these parts. Another instrument which is a great favourite, and found so generally all over the world that we are forced to believe it embodies some unspoken sentiment common to all mankind, is the Jew's-harp, which bears here the very appropriate name of *tchang*. The nomad tribes, and particularly the Kirghiz, have mournful, monotonous songs of great length, some not at all unpleasing to the ear, which differ a good deal in style from the music of the towns, and probably owe their inspiration to the Mongol, and not the Persian element.

The tambourine in different forms is much used, and is the favourite accompaniment to dancing. The latter is not really permitted to the true believer, nor are women allowed to appear in public and dance; but that does not interfere with the desire for a recreation which appeals to the sense of beauty and love of grace inherent in the most primitive race. Youths and boys are therefore trained to take the place of dancing-girls, and are a recognised institution all over Central Asia, although most in vogue in Bokhara and Samarkand.

Besides dancers, there are comedians, su as are seen in Indian and other East countries. These, with whitened faces (wh remind one oddly of the pantomime clown well known to Western playgoers), and bit of rag or a few cloths to simulate vari garbs, will act small comedies, often v obscene and vulgar, but undeniably clev representations of familiar street scenes, bu and seller, *Kazi* and suitor, teacher a scholar, or will mimic animals in an extrem life-like manner.

The festivals of saints, some of whom w merely successful warriors, with no particu claim to sanctity, are great opportunities recreation, which usually takes the form o pilgrimage to the tomb, and a kind of and picnic combined. Booths are erect and the ground is covered with tents and li enclosures, in which music and dancing largely patronised.

There are certain epochs in the life of Mussulman in Central Asia which are a marked by feasting and merry-making.

Among the Sarts — the dwellers in to (practically the merchant and artisan clas of Central Asia)—a boy is considered ma ageable from the age of fifteen or sixte and a girl between eleven and fifteen, or ev earlier, although this is becoming rare. T courtship, as in all Mussulman countries, carried on through a third person, who ranges the amount of *kalim*, or purcha money, which is not always paid to parents, as among more primitive tribes, is a kind of marriage settlement. Before marriage feasts are given by the bride to friends, and by the bridegroom to his, and the wedding-day a grand feast to all frie and relations is given in the bride's hou The marriage ceremony is performed by *mullah*, or priest, but neither of the c tracting parties are present, being rep sented by male relatives. The wedding p sents are usually given by nines, that bei the sacred number; and the guests not o bring, but receive, gifts. When the ce mony is over, the bridegroom can go the women's court and claim his bri Probably she will be concealed ami a group of women, and he must find l hand before he can lead her out—no ea task, as he has most likely never seen l before!

The position of women in Mussulm countries can never be enviable, but in Cent Asian towns she has certain rights, and if l

sband does not provide for her in the way
s means allow, or that by rank she is entitled
, she can complain to the *Kazi*, or judge, a
tive functionary who in many places has
en allowed by the Russian conquerors to
ntinue in his former position. The *Kazi*, if
think fit, can empower her to borrow money
her husband's account, or even sell his
operty to obtain what she wants. Divorce
, however, easy for the husband, who need
ve no reason, but must, if he parts with her,
turn to his wife all her belongings. She can
so obtain a divorce if she can show good
ason; and there is no obstacle to her re-
arriage unless her husband curses her, as he
ay if she has been guilty of any heinous
ime.

The nomads naturally cannot afford the
asts which are the great indulgence and dis-
pation of the Sarts. Still, they have their
wn idea of amusements, and foremost among
ese are horse-racing and a game played on
orseback called *Kok-bura*, or "grey wolf."
he latter reminds one of polo, if one can
nagine polo played on a vast steppe, with
ometimes as many as a hundred players.
ne man has a dead kid slung from his saddle-
ow, and the object of the others is to bear
way this kid and carry it safely to the judge.
he skill of the Kirghiz in managing their
orses, and the keen zest with which they
nter into the game, make it very exciting and
nteresting to watch. As for horse-racing, it
a passion with all the nomads; and camel-
acing is also popular, the ungainly beasts
eing sometimes driven by women or girls.
he number of entries for a single horse-race
ot up at Orenburg not many years since was
ver a thousand. Rather a difficult post must
e that of starter on a Central Asian race-
ourse!

The Russian Government does everything
n its power to foster the breeding of horses—a
ery important matter in such a vast territory,
here the maintenance of order is largely
ependent upon irregular mounted troops.
here are large studs for cavalry and artillery
emounts in the Orenburg district and
urkistan; but, indeed, wherever a Cossack is
ound, there will be horses. These hardy
oldiers, themselves only second cousins to the
Kirghiz whom they have subdued, are, like the
omads, born horsemen; but, unlike them,
hey take an interest in the improvement of
heir breed of horses.

Travelling in Central Asia is usually accom-
plished either on horseback or in a cart resembling the Russian *taratass*, and is neither comfortable nor speedy unless good animals have been procured. The Russian post-roads in Central Asia are not level *chaussées*, but merely show the direction of the track, which is marked out by post relays, and a few settlements and towns. The posting stations are generally kept by a rich Cossack, who manages this in addition to farming and keeping an inn. He has to provide by contract a certain number of post-horses and *telegas*. The postal communications are under the control of a *smoitritel*, usually an old soldier, who examines all the passports, and has also to see to the replenishing of the inevitable *samovar*, getting a few copecks for his trouble. The station has a bare whitewashed room for the convenience of travellers, containing little furniture but a table, some wooden stools, and the tea apparatus. Sometimes the posting station is a Kirghiz tent, and in past days not unfrequently consisted of nothing but a water-cask and a post besmeared with Russian colours. The *telega*, or posting car, is a small open wooden cart, scarcely five feet in length, resting on four small wooden wheels, and running on two wooden axles. In the steppes the wheels frequently have neither metal rims nor boxes, so that the axles catch fire in spite of being perpetually greased. A feather and a jar of grease are an essential part of a traveller's equipment, and he must personally and at short intervals superintend the greasing if he wishes to avoid a breakdown and the serious consequences. On the front box of the *telega* the coachman, or *jemschtchik*, is perched, and the traveller must make a seat of a bundle of straw, or his bag lashed to the cart. To this he must stick as closely as he can, while the Cossack horses gallop madly with the *telega*, which is innocent of springs, across the trackless steppe, over streams and hills and trunks of trees. The traveller after a few days of this sort of journey is almost deprived of feeling, indeed of any sensation, and those unaccustomed to it require some time to recover; yet the couriers, who carry important despatches, travel so night and day for several days, only waiting at each posting-station for tea, while fresh horses are brought. Innumerable glasses of tea, a few biscuits and eggs, frequently form their diet on the journey, and sometimes not even this. The difficulty of transporting troops and arms in such a country and for such distances may readily be imagined, and it is marvellous to think that Tamerlane traversed

these deserts with a million men. Modern armies, with their elaborate organisation—especially intricate commissariat and ambulance—can never accomplish what has been done in the past on many occasions by hordes of nomad horsemen; subsisting like the hardy animals that carried them on what they could pick up on the almost barren steppe—roots, dried meat, or a bird shot and hastily cooked.

One of the most characteristic features of life in all parts of Central Asia is the custom of present giving, which has attained proportions undreamt of in Western lands, though even there it is still an important factor in social life. Presents in Central Asia are by no means voluntary or spontaneous, being given and received as a matter of course, and it is not customary to return thanks for gifts until one is congratulated on receiving them, when thanks must be returned — not for the gift, but for the congratulations. They would become a serious tax were it not that whoever receives a present must promptly give one in return. Among the Kirghiz (who carry the custom to great lengths, despite the fact that their only wealth consists practically of the tent they live in and their flocks), etiquette demands, for instance, that at a funeral feast every mourner that attends must receive a present; but then he must always bring one with him, and the two must be of equal value, so that the proprieties are satisfied, and no one is either loser or gainer in this game of forfeits. Amusing stories are told of gifts sent to each other by the rulers of the various Khanates, in pre-Russian days, which eventually found their way back to the original sender. This system in Central Asia is a great nuisance to a stranger, who, wishing to join at all in social life, is confronted at the outset by what seems an overwhelming tax on his resources and ingenuity. A native who offers the smallest civility or present—a bunch of grapes or flowers—will remark, as he does so, "*Sillau keryak*"—a present is necessary.

All over Central Asia we find traces of a civilisation so old that it has been entirely forgotten, and nothing remains to tell us what were the races who dwelt there, or how they fell from their high estate. On the north bank of the Syr Daria, all along the valley, are numerous ruins which mark the site of former cities; and legend says that this district, now a wilderness with an occasional Russian fort or small half-savage town, was once so densely populated that from Kashgar to the Sea of Aral "the nightingale could fly fro branch to branch, and the cat walk fro house-top to house-top." No investig tions have as yet given a clue as to th identity of the once busy dwellers in th fertile valley, nor why their towns fell int decay. The country is quite capable of sup porting a population; in summer, plants an flowers of many varieties bloom on the steppe and the brush which grows on the river bank forms a cover for quantities of pheasants, gees partridges, and other game.

Nearly all the tribes who, until the Russia era, possessed the soil in Central Asia, da themselves back to Genghiz Khan; but a account of his conquests, given by a Chine statesman who accompanied that warrior durin his progress West, in the early years of th 13th century, gives a description of man towns which existed then and are still standin such as Hodjent, Samarkand, and Bokhar It is almost certain that Central Asia was nev under a homogeneous rule. Genghiz Kha sweeping from east to west, gathered up a the little tribes, and destroyed many ancie kingdoms; but he immediately divided h immense territories between his sons, and the when their turn came, did likewise, so that th family of Genghiz became a sort of hereditar aristocracy over the whole of Central Asi Thus, among Kirghiz, Kara-Kirghiz, Kalmuk Uzbeks, and all tribes which have any of th Mongol element, the "white bones" still lov to boast of their descent from the conqueror.

When one considers the numbers of race which have met, amalgamated, or in man cases simply settled down side by side Central Asia, one cannot be surprised at certain amount of confusion in their method reckoning time. Simplest of all, the Kirghi having no era from which to date their year use a twelve-year cycle, and give to eac cycle the name of an animal, the name being arranged in a certain sequence. Th day of the year is not regarded at all, ever one born in the same year being considere as of the same age. The Kirghiz day i divided into four parts—sunrise, eating-tim midday, and sunset. Seven days make week, or *atna*, while the year is divided int twelve solar months, bearing names corr sponding to the signs of the zodiac in Arabi This calendar is far more complete an sensible than that now being introduce by Russia — the Julian, which is alrea more than twelve days out of its reckonin Besides these zodiacal names, the Kirghi

ke all simple people, have given titles to the onths descriptive of their occupations at fferent times of the year; and, much as the nglish labourer talks of sowing-time, harst, and hay-harvest, the nomad speaks of mbing-time, mare-milking season, and the aughtering season. The Kirghiz are well quainted with the stars, by which they steer eir path in the desert, as well as using them calculate time. The same solar year, with velve months named after the zodiacal signs, in use among all agriculturists, the months aving in Tashkent alternately thirty and irty-one days, while the last month has in dinary years only twenty-nine, with an xtra day every four years. In other cities, nother system is adopted, rather less regular, nd containing one month of thirty-two days nd two of twenty-nine—a method common agriculturists in Persia as well as Central sia, and in the former country also used by overnment in the assessment of taxes. A yme, resembling our own "Thirty days hath eptember," is commonly used in both couns to keep the different days of the month the memory. There is also the ordinary Iussulman calendar, consisting of a lunar ear, used in all religious documents and by e educated classes generally, and since the ulian calendar has been introduced by the ussians, great confusion has inevitably nsued.

Such, briefly, are the conditions of life and ain characteristics of the people of Russian entral Asia, who, by their incorporation into the reat Russian Empire, have acquired an importnce which could never have been theirs while ey remained broken up into a number of petty tates. Never, since the short period of the scendency of Genghis Khan, has Central sia been united under a homogeneous rule. have not time to enter into details of the ethods adopted by Russia in managing this ast territory, but it is sufficient to say that er rule, though quasi-military, is on the hole beneficent; and that although she akes little attempt to civilise, she partly, no oubt for that very reason, succeeds in securing he peace of her new, and at first unwilling, ubjects. An unswerving policy, merciless to ll signs of revolt, coupled with very little intererence in their lives and habits, is the golden ey of Russia in her dealings with the conuered; and with this she has not only pened the gates of Central Asia for herself, ut has effectually locked them against every ther Power.

The question of communications is one which is never absent from the schemes of Russia. What she has already done to link the far distant parts of her possessions to their sovereign and head cannot be recapitulated in this paper, nor have I time to describe the measures which are being taken in Central Asia itself. It is enough to say that Russian lines made by Russians for Russia now run longitudinally across Asia, from Moscow to the China sea, from Batum in Transcaspia to the western gates of the Chinese Empire, and to the Herat province, the key of Afghanistan, which is the outwork of India. New lines will soon join her present Trans-Caspian system with the European-Russian railways and thus provide alternative routes to the present inconvenient transhipment across the Caspian. The importance of these railways in a practically riverless country does not need to be emphasized, and the rate at which these lines are carried out, especially that through Kusk southwards, shows what importance Russia attaches to railway communications.

DISCUSSION.

The CHAIRMAN said Mr. Colquhoun had so closely confined himself to ethnographical and geographical information that it was rather difficult to discuss the paper, without touching upon some of those larger questions which he had judiciously avoided, though he felt sure he held very decided views upon them. He had referred in one place to a proverb which showed that at one time the country from Tashkent to the Sea of Aral was thickly inhabited, and said there was no explanation of how those towns fell into decay. It appeared to him that the greater part of Central Asia belonged to the comparatively rainless belt which stretched right across Asia and Africa, and that the secret of its fertility and prosperity was largely a matter of irrigation. He imagined that in such countries, irrigation had always been the affair of the Government, and he would ask if it was not the case that after the first prosperous period of Mussulman conquest, few Governments had been sufficiently energetic and permanent to maintain those systems of irrigation by which the country was at one time made prosperous and populous. The practical interest in the question of Central Asia arose from the necessity which was laid on Great Britain to fulfil her responsibilities and maintain her position in India, and from the probability that the constant advance of Russia across these regions, and her gradual absorption of these various tribes must, sooner or later, lead to a conflict for supremacy in Asia between Russia and England. These feelings were at the back of all their minds when these questions were discussed, and could not be suppressed. For this

reason he regretted to find that the paper was limited to Russian Central Asia, as there seemed a possibility of Russian expansion very much further to the East, beyond the Pamirs, towards the high tableland between the Khokandland Mountains and the Himalayas, and he wished Mr. Colquhoun had gone a little into the ethnology of that district, and shown the connection between that part which was now Russian and the region further East, to which, in all probability, Russia was directing her eyes. He had been much struck with the passages referring to the Russian administration, of which a sample was the statement that no change was to be observed in the bazaars of Tashkent since the Russian occupation. He would like to ask if that was typical of the Russian administration, for as all who had been in India were aware, the British administration could not be charged with that sort of neglect. You could not go into a bazaar in India without seeing—not great changes in the ways and customs of the natives, but the beneficent results of the British system, not merely in preserving order, but in facilitating trade and business. In another passage a contrast was drawn between the two systems, which was favourable to the Russian, which did not allow—as the English did in India—the land to pass into the hands of mere moneylenders. No greater weakness existed in the position of Great Britain in India than that due to the fact that especially in the Panjab and the north-west, owing to the introduction of the English system of law and mortgages, the Hindoo moneylenders were much strengthened in their position. Previously the country had been somewhat disturbed, and the farmers could not borrow to any serious extent. Under the protection of British law, the land became more valuable, and the farmers were able to borrow more largely; after a few years the farmer found he could not pay, and then the moneylender produced his mortgage and got possession of the land. Thus the native farmer, who was a Mussulman and an admirable soldier, was in too many cases dispossessed by the moneylender, who was not a soldier, and was not particularly attached to British rule. In some parts of India this had been the cause of widespread discontent, and many were hoping that some change would be effected during the present vice-royalty.

Mr. F. H. Skrine said he had listened to the paper with great interest, because he had travelled in Central Asia himself, and last year in collaboration with Mr. Denison Ross, wrote a book called "The Heart of Asia," in which they described the scenes related by Mr. Colquhoun. He could bear testimony to the accuracy of his description in the main, but noticed one or two minor inaccuracies. Mr. Colquhoun referred to Kuldja as being within the tropics; he was not quite sure of the latitude, but it was at a great elevation, and was as healthy as any part of Europe. The speaker had seen at Samarcand, Askabad, and other Central Asian towns, Russian colonists from Kuldja w looked the picture of health; but that did apply to all parts of Central Asia. His frie General Kurapatkine, the Minister of War, founded thirteen or more military colonies towa the frontiers of Afghanistan, which had prov failures; the children were ricketty and the m took to drink, and he believed it was in conte plation to break them up or move them eastwar Again, it was said that no good coal was found in th region, but he had seen in the museum at Samarka lumps of coal equal to the best Welsh, and was t by a young Scotchman, who has settled there, th mountains of coal of the finest quality were to found in the valley of the Zerafshan. There w also other minerals, and he believed there was veritable Klondike lying buried in the mountai beyond Samarcand. They had heard a great deal abo the Khirghiz, but, in his opinion, they were n nearly so interesting a race as the Turkomans, wh had a nobility of character and mien which recall their ancestors, the Parthians, who at one time s the whole empire of Rome at defiance. Among them women had a high position; they were treat as equals, and bore the mark of independence their queenly gait. With the Turkomans alone Central Asia did women take their proper plac and it would be a great loss to civilisation if type like that were allowed to perish. The Russia had found it necessary to show great severity i putting down signs of Turkoman independence, an the result was that they were disappearing like th red men described by Fenimore Cooper. Anoth matter for regret was the disappearance of the Turkc man horse, which within living memory was superic to any animal ever foaled for his endurance, docilit and affection for his master. The breed was no dying out, because the raids in which it were so impo tant a feature had been sternly repressed. The horse now bred in Central Asia were very poor creature indeed, and, in fact, the Cossacks were mounted o ponies from the Caucasus and the Don. He was please to see that Mr. Colquhoun had shown an imparti spirit in dealing with the Russian administration He (Mr. Skrine) had gone from the botton almost to the top of the Civil Service in Bengal and had governed millions in his time, so that h went to Central Asia with some knowledge o how to manage Oriental races; and his impressior was that the Russian Government was bene ficent, and sought the well-being of the subjec peoples. Many mistakes, of course, had been made. With regard to the Kirghiz, it was unfortunate that the native chieftains had been superseded by a sham system of election; but those chieftains had too much power for an autocratic Government. With regard to Turkestan proper he must say the Russian administrators had shown a sympathy and consideration for the people, such as was only to be paralleled in British India, the administration of which he believed was to a great extent copied. In India

still had the school of John Lawrence, Henry ntgomery, and many others; and in Russia there a class of men of the same characteristics, called school of Abramoff, after whom was named a levard in Samarcand, and who had left a grand repu-on behind him in Central Asia. The district officers subordinates were about on a par with the same s of men in India, and the people of Central Asia e, on the whole, about as happy as those in our territory. He had no doubt that the change in ate referred to was largely due to defective irri-on. In 1780 Merv was the most glorious city entral Asia. The stems of vines there were as k as a man's body, they bore tons of grapes, the fields yielded four or five crops a year—owing to enormous irrigation works; but when Amir of Bokhara invaded it in 1780 he destroyed grand embankment across the river above Merv, the whole country went out of cultivation. He ridden over miles and miles of desert, like the ara, but scattered with ruins, and no doubt the e process had been at work elsewhere. About the of our Queen Elizabeth the river Oxus suddenly nged its course, and many thousands of square s, formerly watered by it, became a hopeless rt.

Ir. E. E. Thorburn said you could not have irri-on without water, and you could not have water out rain, and according to his reading, the reason Central Asia was desiccated, was that owing to cutting down of the forests and other causes, the fall had very much decreased. With regard to Chairman's remark about the passing of agricul-l land in the Punjab to professional money-lers, chiefly Hindoos, he might say that there was y probability of a law being passed this summer Simla, under which the power of alienation by culturists to non-agriculturists would be limited period of 15 years, after which the land would rn to the family of the alienor.

Ir. Martin Wood referring to the Chairman's arks as to what was in everybody's mind when king of the advance of Russia in Central Asia, he thought the present paper tended to confirm opinion, now thoroughly established, that ereas Russia was impregnable to us in Central a, so we in India were impregnable to Russia. th regard to the aridity of the country, it was erally acknowledged that want of rain was owing want of forests, and the origin of this desiccation st be the destruction of the forests by conquerors the improvidence of the people. He was glad to r from Mr. Skrine that coal existed there, and to hear his remarks on the Turkomans. They st all regret the manner in which these were ssacred by their Russian conquerors, but he ught that much the same kind of treatment was lied to the Khirghiz as early as 1870.

Mr. Colquhoun, in reply, said in the present paper it was not open to him to enter upon the questions of policy and politics, in which he was especially interested; and in discussing these countries and peoples, the line of demarcation was so very indistinct, that it was difficult to say where Central Asia ended and the neighbouring countries began, and one had therefore to be all the more cautious. It was very difficult not to stray into subjects of much more vital interest; and, as the Chairman had indicated, the real point of interest lay not in the countries of which he had been speaking, but in the Central Asia which was gradually approaching India, making its way steadily, year by year, down to the Persian Gulf, and which had already made its way across thousands of miles to the Far East, and had now firmly established itself in the China seas, and was driving a wedge right through the whole Chinese empire. But these questions were not within the scope of the paper; he could only indicate briefly his conviction that if Russia was as busy as she could be in pushing forward her railways, the object was not simply pacific and commercial, but strategic. No one in his sober senses who had been in those regions, or who took a map of Asia and tried to recall the stages of the Russian advance, could bring himself to believe that the object of this rapid expansion could be anything but a political one. With regard to the question of irrigation, no doubt many parts of this region were very prosperous at one time, and the Russians themselves entertained the hope that by means of irrigation they might be restored to their former fertility. Mr. Thorburn, the distinguished author of "Our Asiatic Neighbours," had rightly indicated that irrigation would be extremely difficult in Central Asia. The conditions were very similar to those in another part of the world, in which great interest was taken just now, viz., South Africa, where in the great central plateau reaching from Cape Colony to the Zambesi and again northwards, the timber which once existed had been cut down or wasted by fire, and the deficient rainfall had not enabled it to be replaced. Afghanistan and Persia were outside of his subject, but he must remind them that Russia, though not actually in occupation of Herat, was near it, and was making her way south, yet the whole of this movement did not seem to attract any attention in this country. It seemed inevitable under our political system that the country could only give its attention to one thing at one time, and while we were engaged in South Africa most important events occurred elsewhere which no one seemed to notice. Amongst these were what was now happening in the north of China, in the neighbourhood of Japan, and in Central Asia, as well as what was being accomplished by the partner of France in Morocco. He had no desire to make too much of the contrast between the Russian and British modes of administration, but there was a great difference. He did not think that

Russia had done much for the education and improvement of the natives, such as Britain had done for India, but he quite agreed with the Chairman, that the English policy in the north-west provinces with regard to moneylenders had not been altogether wise, and that we had alienated to a large extent the sympathies of the people on the frontier, the real fighting backbone of India. No one who had been in India could doubt the impolicy of this. The moment we lost the confidence of the fighting races, we should find it extremely hard to hold our own; and the Hindoo moneylenders, although glib of speech and clever, had no military instinct. He was not sure that the fact of a specimen of coal being found in a museum was proof that it could be found in payable quantities in the country. Coal might exist, but so far it had not been worked, and the Russians reckoned this one of the great drawbacks to the country. Mr. Skrine's comparison of the disappearance of the Turkomans to that of the Red Indians was very apt; they were probably one of the most interesting races in that part of the world, though he was not aware that they possessed all the fine qualities Mr. Skrine had attributed to them. Russia was not the only Government which, under somewhat similar conditions, neglected to preserve a breed of horses. There was not a country in the world, except Central Asia, where horses could be bred and reared so well as in South Africa, and yet we had seen a force of 240,000 men there kept idle for weeks, if not months, for want of horseflesh. He had received great courtesy and kindness from the Russian officials, but he did not take quite the same view of them as Mr. Skrine. No doubt wherever they went they replaced the existing system by something rather better, but it was a very different system from that introduced by our countrymen into India. There was no liberty of the Press or of speech, and, however well the country might be administered it was by a despotic and autocratic Power, and under such rule you could not expect officials to be what Anglo-Indian officials were, working under a free constitution. The Government of India had made many mistakes, and was still making them, but the endeavour was always to elevate and educate the native. In Russia they did nothing of the sort; they simply ruled for their own advantage. He could not subscribe to the theory propounded by Mr. Martin Wood, for he was quite certain England was not impregnable in India, and unless measures were taken to arrest the Russian advance through Central Asia to the Persian Gulf and the Indian Ocean, there would be grave difficulties in the future. Russia might be impregnable in the heart of Central Asia, but when she came towards the Persian Gulf and to the China Seas he did not think she was at all impregnable.

The CHAIRMAN then proposed a cordial vote of thanks to Mr. Colquhoun, which was carried unanimously, and the proceedings terminated.

TRANS-SIBERIAN RAILWAY.

According to *L'Economiste Français* the leng rails laid down in nine years amounted to 3,356 r which gives an average of 373 miles per year. (munication will be established this year betwee European continent and Vladivostock, partly b and partly by steamship; the time occupied fo journey will be about 17 days. The total leng the Trans-Siberian railway, including the line Manchuria, will be 5,512 miles.

MEETINGS FOR THE ENSUING WE

MONDAY, JUNE 4...Royal Institution, Albemarle-street 5 p.m. General Monthly Meeting.

TUESDAY, JUNE 5...Royal Institution, Albemarle-s W., 3 p.m. Mr. R. Warwick Bond, "R the Servant of Art."

Anthropological, 3, Hanover-square, W., 8½ Dr. J. G. Garson, "The Metric System of Id fication used in Great Britain" (illustrated lantern slides).

WEDNESDAY, JUNE 6...Geological, Burlington-house, 8 p.m.

Archæological Association, 32, Sackville-street 8 p.m.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Archæological Institution, Oxford-mansion, Ox street, W., 4 p.m.

THURSDAY, JUNE 7...Linnean, Burlington-house, W., 8 1. Mr. E. S. Goodrich, "A Viviparous S Worm." 2. Dr. A. Staff, "The Genera P neuron Gilg and Dicellandra Horkf." 3. Embleton, "The Structure and Affinitie Echiurus Unicinctus."

Chemical, Burlington-house, W., 8½ p.m. 1. W. S. Mills, "Diphenyl and dialphyl-ethyl diamines, their nitro-derivatives, nitrates, mercurochlorides." 2. Dr. S. Ruhemann and H. E. Stapleton, "Condensation of ethyl a lenedicarboxylate with bases and β-ke esters." 3. Dr. H. A. D. Jowett, "The cons tion of pilocarpine." 4. Drs. F. D. Chatta K. J. P. Orton, and W. H. Hurtley, "The nitr chlorides derivable from m-chloroacetanilide their transformations." 5. Dr. A. Lapw "Derivatives of cyanocamphor and homoc phoronic acid."

Royal Institution, Albemarle-street, W., 3 Rev. Canon Ainger, "Chaucer." (Lecture I.

United Service Institution, Whitehall-yard, S. 3 p.m. Mr. A. R. Colquhoun, "The G Trans-Siberian Railway."

FRIDAY, JUNE 8...Royal Institution, Albemarle-street, 8 p.m. Weekly Meeting. 9 p.m. Dr. A. Macfad "The Effects of Physical Agents in Bacterial Li

Astronomical, Burlington-house, W., 8 p.m.

Physical, Chemical Society's Rooms, Burling house, W., 5 p.m. 1. Dr. S. W. Richardson, " Magnetic Properties of Iron and Alumin Alloys" (Part II.). 2. Mr. W. Campbell, "N on Crystallisation produced in Solid Metal Pressure." Dr. C. H. Lees, "The Viscosit Mixtures of Liquids and of Solutions."

SATURDAY, JUNE 9.. Botanic, Inner Circle, Regent's-p N.W., 3¾ p.m.

Royal Institution, Albemarle-street, W., 3 p Sir Frederick Bridge, "The Growth of Cham Music." (Lecture III.)

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FRIDAY, JUNE 8, 1900.

communications for the Society should be addressed to 'he Secretary, John-street, Adelphi, London, W.C.

Notices.

CONVERSAZIONE.

'he Society's *Conversazione* will take place the Natural History Museum, Cromwell-d, S.W. (by permission of the Trustees of British Museum), on Wednesday evening, 20th June.

'he reception by Sir John Wolfe Barry, .B., F.R.S., Chairman, and the other mbers of the Council, will commence at .m.

'he following portions of the Museum will open:—On the Ground Floor—the Central l, North Saloon, Fossil Mammalia and otilia Galleries; on the First Floor—the t and West Corridors.

. selection of music will be performed by the id of the Coldstream Guards in the Central l, and by the Band of the Royal Engineers he Fossil Mammalia Gallery, commencing o'clock.

ach member is entitled to a card for him- (which will not be transferable), and a l for a lady. These tickets are now in 'se of issue. In addition to this, a limited iber of tickets will be sold to members of Society, or to persons introduced by a nber, at the price of 5s. each, if purchased re the date of the *Conversazione*. On day the price will be raised to 7s. 6d.

hese tickets will only be supplied to non-ibers of the Society on presentation of a r of introduction from a member.

embers can purchase these additional ets by personal application, or by letter essed to the Secretary. In all cases of ication by letter a remittance must be osed. Each ticket will admit one person, r lady or gentleman.

ght refreshments (tea, coffee, ices, claret &c.) will be supplied.

e entrance to the Museum is in the Crom- road. Carriages must enter the grounds by the East Gate, and leave by the West Gate. The cards must be given up on entering the Museum.

Visitors arriving or leaving by either of the Metropolitan Railways will be allowed the use of the District Company's Subway, which leads from the South Kensington Railway Station direct into the grounds of the Museum.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

Proceedings of the Society.

INDIAN SECTION.

Thursday, May 17, 1900 (at the Imperial Institute); The Right Hon. Lord George Hamilton, M.P., in the chair.

The paper read was—

THE INDUSTRIAL DEVELOPMENT OF INDIA.

By Jervoise Athelstane Baines, C.S.I.

At the opening of the present Session, I was honoured with an invitation to address this Section on Indian industries. The selection was made, I hope, on the grounds of the desirability of getting a good discussion on a subject which the events of the last few years have brought into unusual prominence, rather than from any notion that I am supposed to speak with authority upon the numerous and important questions involved. I set myself, therefore, to do no more than, as announced in the notice, to "open a discussion." To deal exhaustively with the subject requires certainly more time than I have at my disposal, and more confidence than I possess in my own experience and judgment. The only man to undertake the job is a cold-weather tripper, who knows his Blue-books, distrusts every one drawing a salary, provided he be a fellow-countryman, and is thoroughly impressed with the incapacity of the Secretary of State for the time being. Such an observer stands in the fourth dimension, and however weak may be his grasp of the past and present, he is in a position to speak confidently as to the future, if only his advice be taken. But the closer one's acquaintance with India, the

more vividly does one realise the narrowness of the field within which it is safe to generalise from individual experience of conditions so vast and so varied. Certain important and well-defined characteristics and tendencies can no doubt be demarcated, and an average be struck which, though it may have no real existence, will serve as a measure of the deviation from it of the facts of different classes or localities. In this way, the experience of one who has kept his eyes and ears well open during the term of his residence in India may provide him with a framework, as it were, of general conceptions; and this, if duly kept from too intimate a contact with the imagination, will serve as the lay-figure on which he can examine the cut, set, or fit, of new suggestions or measures affecting the social or economic life of the most interesting, as it is the largest, aggregate of our fellow-subjects. We must avoid, of course, the risk of becoming Pygmalions, so besotted with our own creation that we can't bear to bring it up to date, a risk which all of us incur when once we have put off our official armour, and are no longer in daily touch with the everyday life of India, but are reduced to trot out our antiquated image, to use the immortal expression of the biographer of Mr. Justice Onerkool Mookerjee, "in all the hideous nakedness of its *cui bono*." I speak feelingly, as I am conscious of "damnable iteration" myself, when I refer to productions which, if I may appropriate a remark made on himself by that distinguished member of the present Government who is the most frequently reminded of his former utterances, "I always peruse again with interest, often with respect, and occasionally even with admiration!" I here offer nothing new or original, but simply do my best to marshal a certain number of general considerations in such a way as may conveniently elicit the views of those whose "judgments in such matter cry in the top of mine," whether in respect to the subject as a whole, or on some special aspect of it which may have come under their personal observation.

By way of preliminary, it seems as well to set forth the main features of the industrial conditions which, as it appears to me, prevail more or less generally throughout India in the present day. The position, as a whole, is unlike that of any other country, even in Asia. On the one hand, India has resisted that almost excessive imitation of the West, which is the chief feature of modern Japan; it is almost as far removed, on the other, from the immobility of inland China. On the whole, the closest analogy from an economical standpoint is that of parts of European Russia. But there, again, the climatic conditions have given rise to a combination of agriculture with manual industries, exercised during the long winter, for which the perpetual outdoor life of the tropics affords no opportunity, and to this extent curtails the versatility of the population. In many other respects, however, the life of the peasantry, their village organisation, their attitude towards the town and its denizens and towards the law of the land, their devotion to their fields, the position of their womankind, their finance and the extent to which thei religion is interwoven with the affairs of every day life, all these, as described in the pages o Sir D. M. Wallace, almost make one forge that he is not writing of the East.

It is with this village existence, indeed, wit its resources, needs, aspirations and capa bilities, that we are concerned on the presen occasion. In the minds of the modern West no doubt, the phrase industrial developmen connotes the hum and smoke of busy fac tories, such as those to which Lord Curzo called attention a few weeks ago, in on of his speeches, as being, from an æstheti point of view, detestable, thus sparing h audience the more sulphurous flavour whic Ruskin was wont to impart to the expression his views on the same subject. It is true th Viceroy proceeded to do justice to the imm diate benefit derived by the community fro the enterprise of which the outward system so unlovely. But here, again, we touch on the fringe of the great question. The ta chimney is a landmark in the development the country, but its smoke floats over the ci only, and to more than nine-tenths of the pop lation, therefore, the hum of its machine bears no message. Factory enterprise has u doubtedly made great strides within the pr sent generation, and is sure to extend with t improvement of communications, but very mu is not to be expected in this direction at pr sent. In the first place, India entered the fie long after the manufactures of more advanc countries had got a grip of the markets of t world, and though not without advantages s has an abnormally long leeway to make up the journey of competition. She has, aga geographical difficulties to contend again Her mineral products, which are only n beginning to be systematically exploited modern lines, are awkwardly placed for use

combination with each other, and for transport to convenient centres. There are social and other considerations also to be taken into account, but to these I may perhaps refer later. My only object in mentioning factories here at all is to dissociate them from the indigenous development of industrial India. For this we must look to the rural life of the people. Although from the earliest times of which we have record good use has been made of the metals found in the country, the attention of the people at large has been concentrated upon its agricultural resources, which, in the present day, are almost unparalleled in their extent and variety. Nearly three-fourths of the population are closely connected with the soil. Amongst them, the most honourable calling is tillage. The highest aspiration is to hold land, and along with, possibly even above, their caste, the holding is the object of their most fervent devotion. The foundation of the village community is the landholder, and all other callings admitted into it are subservient to his wants and convenience. The land is held in peasant estates, and whatever the form of tenure, the policy of the Government, ever since the fatal misconception of 1793, has been to strengthen the connection between the land and its actual cultivator. Thus, the most universally agricultural community in the civilised world is emphatically a Peasant Empire. It is to the peasantry that the State looks for the bulk of its direct revenue. It is on the peasantry that the merchant depends for the bulk of his exports, and by whose consumption he regulates the volume of his imports. It is to the peasantry that the artisan owes the character and quality of his out-turn; and it is by the verdict of the peasantry, unspoken, but unmistakeably expressed, that the reputation of our administration must stand or fall.

The tastes and requirements of the vast rural masses of India, therefore, are the chief factors in the industrial development of the country, and it is with reference to this standard that the supply must adjust itself. There is no lack of evidence that the standard is expanding, both in cost and variety. The movement may be scarcely perceptible to those who live continuously in the same surroundings, but it is very apparent after a few years' absence, or if one's memory can accurately recall the circumstances of a decade or two ago. A long period of peace and efficient protection has conduced to a far greater mobility in the community, from top to bottom. The village circle is no longer as self-contained as it was obliged to be in the days of unsafe travel, and the artisan, formerly the mere creature of his position in the community, is now at liberty to seek a wider market, and compete with his peers abroad. The landless labourer can yield to the attractions of a distant town, and the farmer can do his own bargaining after harvest, instead of submitting passively to the discretion of the village grain dealer. Even the great institution of caste, whilst entirely unimpaired in system, has moved with the times in matters of detail, and fixes, as a rule, only the lower limit to the exercise of function. It is true that book-learning has made little or no practical advance among the classes in question, but the way is being paved for progress in that direction also, though not, perhaps, by the royal road recognised in the Department of Public Instruction.

Although I have devoted the above remarks exclusively to the cultivating classes and the village artisans and menials, I do not ignore the part played in the general movement by the much smaller and more specialised population of the larger towns. It is not within the scope of my subject to speak of the increased opportunities opened to the professional classes during the present generation, as they are but indirectly connected with the industrial question. The commercial stand on a rather different footing. Always keen to take in new situations, they got a long start of the industrial classes when the establishment of the large new settlements of a maritime power in what are now the presidency towns disclosed the endless vista of foreign trade. It is to their enterprise and acumen that is greatly due the dispersal of foreign goods over the retail trade of the whole country, with the not altogether satisfactory result that, above the grade of earthenware and copper, nearly every article in common household use is of foreign origin or manufacture. This consideration brings us to the brink of a vital question, viz., the direction in which it is to the best interests of India that her industrial development should proceed. The line now being followed is simply that of the least economic resistance for the moment. Just as the extension of machinery leads to the increased specialisation of mechanical processes, so the expansion and improvement of maritime communications tends, when undisturbed by political considerations, to the specialisation of commerce. In the competition of most goods of the classes which are chiefly in demand

in India, experience, all the world over, shows every year more conclusively that under existing conditions the race is to the cheap, and that price, not quality, is the determining factor in the trade. In like manner, the predilections of the masses of India run towards cultivation, and the bulk of the produce in excess of home needs is exported, for the most part in its natural condition. So long as matters are on their present basis the peasant sees no reason to change, nor does the merchant. Nature, however, sets a limit to this arrangement, and warns us of the fact through the lamentable means by which a large tract in India has now for so long a period been afflicted.

Famine, it is true, retards for but a comparatively short time the growth of the population, and the burden upon the soil is before long reimposed to its former, or even a greater, extent; but while the stress lasts, all but a comparatively small fraction of the population of the affected tract are reduced to idleness and destitution, since not only the actual cultivators and their labourers, but the village artisans and cattle breeders are all deprived of their means of subsistence. Then, again, the sort of agricultural produce exported from India does not, with the exception of the rice of Burma and the coast districts, form part of the food supply of the masses, which consists generally of millet and pulse. In these last there is very little trade beyond India itself, nor, in turn, is there a supply abroad which could be introduced into India in case of the local stocks falling short. It is clear, therefore, that in course of time, either means must be adopted to increase the home produce of food off the area under the plough, or that area must be enlarged proportionately at the expense of the acreage set aside for the export market. I am assuming, of course, that the whole arable area has been occupied—a condition which is not yet in sight, save in a few specially congested tracts. Nevertheless, it is as well to look forward to what, under present conditions, is inevitable. The merely numerical figure of density is no guide, of course, to the economic burden on the land, as, to take two of the most extreme cases, the district of Ratnagiri, with about 280 to the mile, is as heavily weighted in relation to its supporting power as Saran, with over 900, and both are already taking to seasonal migration of large bodies of their population.

In addition to the increasing pressure upon the agricultural resources of India, and the uncertainty of a continuous rise in production, there is the further consideration that the present commercial system rests entirely upon the freedom of molestation of the great sea-routes, and that this, in turn, depends on the maintenance by this country of her mastery of the seas. The interruption for any considerable period of the maritime trade of India would mean, in the present circumstances, the curtailment of most of what were, in the preceding generation, luxuries, but which have since been assimilated and become the ordinary necessaries of life.

The conclusion to be drawn, then, amounts to this, that whilst no step should be omitted towards the improvement of agriculture and the amelioration of the conditions of the so-called famine zones of the country, every possible inducement should be put forward to encourage the masses to devote themselves to non-agricultural means of livelihood. As to the first point, the development of the largest industry in India, little need be said by me here. It has been recognised by experts that the changes required are in the system rather than in the details of cultivation, and experience has shown that in such matters the peasant of the better class is by no means a bigoted Conservative, always provided that the innovation "*oculis subjecta fidelibus*" justifies itself by results, and is not a leap in the dark on the part of an inexperienced Government official "on the make," as is too often, I fear, suspected. In the same category may be placed the improvement and maintenance in proper state of the hybridised crops, such as cotton and some wheats, a most difficult task.

The diversion of any considerable proportion of the lower artisan and the labouring population from their present dependence upon the year's harvest is a far more difficult undertaking, and one of which the initiative must come from within the community, or, at least effort from outside must be met more than half-way by those whom it is desired to influence. It is worth while to briefly review the various directions in which such enterprise has been tried or suggested.

There is, in the first place, the attempt to revive old industries. However laudable this may be, it is not a subject which enters largely into the general position which is being discussed. The conditions under which these arts, for they come largely under that head used to flourish have long passed away. The demand was restricted, since the products were chiefly the luxuries of a Rajput or Mogha

court, and in the present day would probably come principally from foreigners, and would not extend widely even among the rich commoners of India.

I next come to innovations, such as the bringing forward a stage or two the produce which is now exported raw and worked up abroad. Apart from cotton mills, largely owned by Indian proprietors, the rest of the present industry of this description is in the hands of Europeans, so that only the price of the labour remains in the country, and the tea, tobacco, and gunny go straight to the foreign market. The fact that the Indian cotton industry was the result of the Civil War in America, and that the cessation of the supply of Russian hemp during the Crimean War created the jute trade of Bengal, indicates that India is not without opportunities of deriving comfort from the misfortunes of even the Mother Country, and both these enterprises seem to have come to stay. I have assumed that the produce of these industries is, for the most part, for foreign consumption or use. This is true, in the main, in the case of tea, tobacco, indigo and jute, but a fair portion of the cotton outturn remains in the country, though the bulk of the yarn goes eastwards and of the piece-goods seeks East Africa. Again, a considerable start has been made in the manufacture of leathern goods for Indian use in addition to the preparation of the hides for export, an industry that has evidently a fairly bright future. The number of hides and skins that annually leaves India is enormous, and the preliminary stages of fitting them for foreign use, as conducted by the village operator, are both inefficient and offensive. Attention has been given to the improvement of the process in Northern and Western India; in the case of the former, the capital is drawn from this country, but in Bombay the enterprise was begun by a Parsi gentleman, who had his son trained in European methods, and then having provided for the initial expenditure, placed the youth in immediate and personal charge of the works. A further consideration in regard to this departure is the opening of another means of subsistence to a class which stands at the bottom of the social scale, and is prohibited under caste rule from joining any of the more reputable of the traditional occupations of the Hindu community. I may also mention a comparatively small development of the woollen industry in upper India, which has begun to intercept a portion of the produce hitherto exported, and turns out popular fabric. It is possible, but here I cannot speak with confidence, that on the same lines, the local preparation of oil-seed, coir, teak, and perhaps other products may in time be initiated.

From the question of handling the raw produce of the country before export I pass to a topic of equal importance and greater complexity, that is, the possibility of substituting local manufacture for foreign in the case of the numerous classes of goods to which I referred above in connection with the great expansion of the import and retail trade. I may take for granted the position I have already laid down, that the general welfare of India will be best promoted by any step which tends to diminish the abnormal disproportion in number that now exists between the artisan and the agricultural classes. The question of the moment, then, is how the former can secure fuller employment, either by utilising materials to hand in the country, or by working up imported raw material? Superficially, the question is one of price, and this is true of new demands, though not of old, for there is evidence that in articles of long and traditional use in the household quality is by no means ignored. The strong coarse cotton wrapper of the peasant of the uplands has never had to succumb before the more showy longcloth of the mill, and so far from the hand weaver approaching the status of the dodo, as some vainly assert, he seems to be absorbing large consignments of the finer counts of foreign yarn in his trade. It is only in rare and special instances, again, that the metal household vessels are turned or hammered anywhere but in India, though the sheet metal is imported. Nor do the women look abroad for their ornaments, except in the matter of superior glass bracelets. We may take it, then, that with anything near equality in price the more durable article will be preferred. There is this additional consideration in connection with such discrimination, that the indigenous artificer is better acquainted with and more amenable to the taste and requirements of his customers.

On the whole, however, the tussle is between manual labour and steam or water-power, and this brings up again the question of the extension of factory labour in India, to which I have already briefly referred. There are two sides to this, as to every question. The machinery has to be made almost entirely abroad, the coal transported long distances at considerable cost, and the climate is against certain processes. On the other hand, the kind of work seems popular when once

established, the operatives are patient, docile and industrious, the family is kept together, and the supply is abundant. There is a certain moral influence in disciplined co-operation, as in railway travelling, that benefits the Indian character, softens caste asperities, and implants some dim notion of a common object. Both work and pay, moreover, are regular. Whether the labour is cheap or not, is a question not always answered to the same purport. Of course, the remuneration is low compared to that in more rigorous climates, but the standard of work is low also. More hands and more supervision are required, and there is less room for confidence in the conscience and nerve of the Oriental. On the whole, the difference between the two standards is not to be measured by the wage. If it were, I fear we should have ere now heard a great deal more in Parliament, or wherever Lancaster doth speak, of the necessity of stringent factory laws for the protection of the sweated and voiceless Indian, and the levelling up of the Hindu operative to the British standard, even as the Lascar is being levelled into a state of ventilation abhorrent to his custom and, in his view, to his constitution!

I have not yet done with the *pros* and *cons* of factory enterprise in India. Its extension is so far in the right direction that it provides non-agricultural means of support for an increasing number of people, small as the number yet is, compared to the millions to be affected. It does not attract so much the artisan as the landless labourer or the small peasant whose holding is inadequate for the support of his family and who resorts to the factory only between harvests. It concentrates industry round the larger towns, as in other countries, but has not begun to create new centres. Then, again, except in the case of cotton, which is probably the line most open to foreign competition, nearly the whole of the capital engaged in the extension of factories is British, and the enterprise is, therefore, subject to the same drawback as the development of fresh agricultural products for exclusively foreign consumption, namely, that India absorbs only the wages and rent, whilst the profit nests abroad. The remedy for this last objection is clearly in the hands of the Indian capitalist who has every opportunity for contributing to this phase of his country's progress. Enterprising as the leading commercial classes are in their traditional calling, the habit of combining their capital in new channels has not yet been assimilated. It is spreading, however, and there are signs of late years that the old timidity and distrust are yielding to the propagandist influences of British initiative, and that the owners of long-cherished hoards are beginning to agree with that shrewd old philosopher Bacon, that "money, like muck, is of no good unless it be spread." So far as this line of industrial enterprise is concerned, the attitude of Indian capital seems to me the determining factor in the situation, inasmuch as if manual industries are to be organised upon a permanent basis, their benefit must be distributed as widely as possibly in the country itself.

What, finally, is to be the future of the traditional and well-established village industries which cannot be organised upon a brand new system like the more subdivided trades? It is to the respect paid to custom and tradition and to the avoidance of drastic re-reforms and innovation that is mainly due the success which has attended British administration of other civilisations. The humble artisan is an ancient, useful and respected member of one of the most wide-spread of Indian institutions, and is not to be swept on one side by Resolution, like a Vestry or House of Lords, but must be induced to move with the times. He has a keen interest in new tools, but too often applies them to the old work. The caste system provides ready to hand the most admirable raw material for technical training; dexterity, patience, single-minded devotion to the work, and a continuous succession of apprentices. But to take full advantage of these facilities, the training must be brought to him in his home, where the whole family will gather round, and learn by the short road of example, instead of by the roundabout path of precept. Under the present system of technical education in India, this cannot be done, though in the Madras Presidency, I believe, peripatetic instructors are sent to make short stays at different villages for the purpose. Speaking generally, however, the technical institution has not yet got into touch with the classes which of all others would derive benefit from its teaching. I do not speak of the Schools of Art, which devote themselves chiefly and professedly to the revival or improvement of industries which do not enter into the life of the masses, although it is mainly to them that the Indian trade acquired its repute in the early days of European connection with the East. But the other institutions coming under the head of technical seem to rest on a base too

artificial, and to appeal to too small a field. Manual dexterity is fostered more than the method and habit of thought by which it can be directed beyond the bounds of the processes actually taught, and the immediate provision of employment for the pupils takes precedence, to some extent, over the development of the sense of responsibility imparted by building up an independent career. Too many artificers are turned out ready-made, with the shadow of State aid always over them and the hope of its substance ever in their mind. The bullet is ready, but lacks the powder to speed it to its destination.

Indian society being what it is, it is hardly to be expected that its industrial quickening will be effected by the outward application of direct stimulus, either in the shape of instruction or more insidiously, by State dry-nursing. We ought never to forget that we are not considering the conditions of a half-civilised people eager to catch hold of any practice that they may admire in a European, but with an ancient and elaborate civilisation, which, by its successful resistance to centuries of foreign political domination has amply proved how suitable it is to those who possess it, and how deep are its roots in the heart of the people. The very natural impulse of such a system is to look with suspicion upon any methods and proposals of foreigners which may widely differ from their own, and its practice is to adopt no changes except such as commend themselves to their long-matured conceptions. All else beats at the door in vain.

Those outside this iron-girt circle who wish, either for the general welfare or for their own material advantage, to induce some internal modification or strike some fresh chord, can best accomplish their purpose by a process of, as it were, leaving open doors disclosing attractive prospects, or of furnishing the utmost possible number of opportunities for observation and experiment in fresh directions. At some time or other these facilities will surely be utilised. Wants will increase with the means of satisfying them, and an effective demand is always met half-way by those who profit by the supply. India is poor, it is true, in the sense that a good number of her inhabitants exist upon little more than a bare pittance. But in the case of all above this margin, that is, the great mass of the people, it is only when we think in sterling and compare their standard with the standard of living in this country that they are poor. Poverty is a purely subjective condition, depending upon the relation between wants felt and the means of satisfying them. Thanks partly to the easy terms of tropical life, with its few needs, partly, again, to the impassable barrier placed by caste against social ambition, the Indian peasant lives a life somewhat approaching equilibrium. He is not, that is, in anything like the condition of the poorer middle classes in the large cities of the West, nor again, is he afflicted with that "accursed wantlessness" which stands in the way of all social progress.

He has enough wants, in fact, to make for progress. Increased means and increased leisure, said Lord Beaconsfield, are the two great civilisers, and under the former, at all events, the horizon of Indian life is widening. The protection of the law, the equality before it of all alike, and the prominence into which it brings individual liberty and responsibility, in contradistinction to the collective tendencies of caste and village life, contributes towards this result. The appreciation of schooling, a more potent stimulant to the desire for novelty, will probably await the increased leisure. But, meanwhile, the process of education is always going on. The schoolmaster is abroad, indeed, but he does not sit in the class room; he is to be found in the law court, the bazaar, and, above all, in the third class railway carriage. Travel is the great educator of the day. Pilgrimages can be taken from end to end of India at a small fraction of the cost and time that would have been necessary in former generations. In the carriage, as before the law, all men are equal, and caste gets some of its inconvenient corners rubbed off. People are met hailing from parts of India the very names of which were previously unknown, and experiences are duly exchanged, crops are discussed, and, in their own phrase, "matters of sorrow and joy" are brought under review. The traveller sees large towns and the glories thereof, acquires at each portable property as well as experience, and returns to his village a wiser man, with enlarged views and the makings of an appreciation for novelty.

This diagnosis may be incomplete, and in the discussion that will follow may be corrected, and omissions of weighty considerations will be rectified; but, unless my diagnosis be grievously at fault, industry in India will develop itself under such influences as these, slowly, deviously, indeed, but in harmony with the inclinations and

genius of the people, and will thus be ultimately established on a base wider and more permanent than any that could be devised for it by foreign effort, however intelligent, considerate, and, like ours, eager to do or suggest something, if only in requital of that unrivalled experience which we gain from association in the life and administration of our great national charge.

Appendix.

As I set myself out to deal with only the general considerations involved in the question, I did not think it worth while to interpolate the detail of any instances I may have quoted in illustration of certain points. I take the opportunity afforded by an appendix, however, to refer to a few recent sources of information to which I am under obligation. For instance, there is the comprehensive report on the manufacture of iron and steel in India, by Major Mahon, R.A., both a practical expert and a close student of the subject abroad as well as in India. He has carefully scrutinised the nature and sources of the supply of ore, coal, and flux, and reaches the conclusion that, under the conditions he sets forth, a well managed enterprise would be successful. Those conditions are not found in the only enterprise of the kind at present at work in India, though the results, on a comparatively small scale, it is true, are not discouraging. It is only by inadvertence, I hope, and not by anticipation, that the telegraphic address of that undertaking is denoted by so ominous a word as *Fuimus!* I have further to acknowledge the communication by Mr. Chatterton, of the School of Art, Madras, of the results of his very interesting efforts to introduce the use of aluminium for household vessels, efforts which appear to be meeting with considerable success. This will be greatly increased if his endeavour to achieve the local manufacture of this capricious metal by the use of water-power for the generation of electricity attain the desired end. The "harnessing" of Foyers and Niagara, of which we have read much of late, have been followed by the breaking in of the Cauvery, I understand, and Periar still remains an unknown factor in Southern India. In Kashmir, too, the possibility of taming the Jhelum into the motive power of an electric railway has been ascertained. When one sees how much is being done in this line in Sweden and parts of Norway, it is impossible not to look forward to the exploitation of rivers, at least in the north and south of India, where the supply is ample and localities are accessible for the purpose. I have referred in the paper to the enterprise of Mr. E. D. Talati, the master of a High School, who has put his son into the tanning trade, and I am indebted to him, also, for the copy of an interesting lecture he delivered in Poona on the subject of the old and eternal question of "What to do with our sons?" He does not regard the subject in the same aspects as I have done, but so far as he deals with the advisability of getting the professional classes to engage in the promotion of mechanical industries, he says what all will acknowledge to be the wholesome truth. It does not, however, carry us far, under the existing conditions of India, and must long remain a merely superficial influence. But wherever, and in whatever direction it is exercised, it is one which must enlist our cordial sympathy.

DISCUSSION.

Sir M. M. Bhownaggree, K.C.I.E., M.P., thanked Mr. Baines for his very clear exposition of the all-important subject of the industrial development of India. They had both been for some years past collaborateurs in the work of creating public interest in India and in England in this question, and he had the satisfaction of finding that Mr. Baines had emphasised point after point all the arguments which he (the speaker) had from time to time urged as regards the pressing necessity of teaching the people of India to devote skilful labour upon the natural resources of the country. Not only was it the most fruitful, if not, indeed, the only field of operations for the people of India, in order to secure their future prosperity, and to emerge from that chronic state of poverty from which large masses of them suffered, but it was unquestionably the most effective protection against the disastrous evils of the famines which periodically overwhelmed them. He was so firm a believer in this theory, that he had placed on the order-paper of the House of Commons a motion to that effect, the concluding portion of which was in these words:—"That one of the most effective methods by which the rigour of the famine could be modified, and the buying-power of the people now succumbing to them increased, would be to enable large classes of the agricultural population to pursue other industries; and that, therefore, it is the opinion of this House that the Government of India should adopt measures for the elementary industrial and technical instruction of the poorer communities, so as to fit them for more profitable manual labour in other directions besides agriculture." It was gratifying to observe that a great awakening

ıad come, both upon the Administration and the ıeople of India, and that it was freely acknowledged ıow that the salvation of the country depended on arge numbers of the population being fitted for inlustrial pursuits. The noble lord in the chair, as Secretary of State for India, had expressed his strong ıelief on more than one occasion in this proposition. Lord Curzon had not lost a single opportunity to :xpress a like belief, and impress it on the people of ndia. Lord Northcote, even in the short time he ıad been in charge of the Government of Bombay, ıad paid great attention to the subject. Many ·ducational officers had, in recent years, tried, side ›y side with the excellent academic work they ıad been doing, to press on the attention of the tudents the desirability of applying the education hey received to the development of skilled manual vork. While alluding to this class of officers, he felt t his duty to pay a passing tribute of respect to the nemory of one of their distinguished colleagues, Mr. T. B. Kirkham, who, after a career of great academic ısefulness, extending over many years, in Western ndia, had just passed away. The educated classes hemselves, he (the speaker) observed with much satisaction, had now begun to feel that the precious boon ›f education they acquired could be more profitably ·mployed if some of them betook themselves to ndustrial pursuits. He was glad to see among them hat afternoon, Mr. J. N. Tata, who had given recently so munificent a donation for the foundation of . Research University in India. In fact, the ground, nd even the material, was prepared for the reception ›f such instruction as might lead to a large developnent of industries, and the real question was as to nitiating action, which was well put by Mr. Baines n these words: "The initiative must come from vithin the community, or, at all events, any effort rom outside must be met half-way by those whom it s desired to influence." So that, altogether, the irst stage of persuading the people as to the ıecessity of industrial work was covered; and the nain question now was how were those whom it vas desired to influence to be brought to a point of unction with those whose duty it was to launch 'this enterprise." In brief, how was the action to be ›egun? He was not one of those who always said that n all matters of national welfare Government alone ould and ought to take the initiative or carry the vhole work through. He fully recognised that the ›eople themselves ought to bear their proper share of uch work and put their shoulders to the wheel. But he people of India had been heretofore taught to ely on the guidance and help of Government. General education and professional instruction in ndia would never have spread to the extent they had lone without the initiative, the advice, and the support ›f Government. The means for them were altogether upplied by Government, and he firmly believed hat in the matter of industrial and technical intruction the lead and guidance must come from Government. The first step in this direction was to attach to all schools throughout the country, from village schools to high schools, workshops, laboratories, and other agencies, for imparting technical instruction. Many schools in England, and perhaps a larger number on the Continent had their technical classes, and if like means were supplied to our Indian schools, on a scale in proportion to the size and capacity of each, it would be found that large bodies of students from young age would acquire a taste, as they would have thus the opportunity, for developing the talent which they undoubtedly possessed for different industries. The seeds thus sown would bear fruit before many years were passed, and the rising generation of the people of India thus imbued from early years with a sense of the advantages of skilled labour to themselves and to their country, would produce men fitted to pursue those industries the materials for which lie at their very door. There were many other measures which he could mention, as he had done on former occasions, as well calculated to lead to an extensive development of industries in India, but the limit of time which applied to speakers at the Society did not allow of his enlarging on the subject. He would, therefore, content himself with pointing out as he had done the first step which, in his opinion, should be now taken without any further delay, and conclude by thanking the reader of the paper for giving them such an instructive statement of his views on a subject of such vast importance to India, views which would find general agreement both there and here.

Mr. ROBERT H. ELLIOT said that if he had heard this paper two years ago he should not have ventured to speak upon it, but, since then, facts had occurred which he thought ought to be made known. The question was, were the industries of India likely to progress or to decline, and he would take that one with which he had been connected since 1856, the coffee industry. About five years ago that industry was one of the most prosperous businesses in the world, but at this moment—and he had only just returned from India—he found in North Mysore and Southern India generally evidence of decay in every direction. The two chief tests of prosperity or decay were the cash test and the labour test. This year he had lowered the wages on his property 25 per cent. for men, and 33 per cent. for women, and over large parts of the country, wages had been lowered from $12\frac{1}{2}$ to 25 per cent.; and though this change was not quite universal, it was creeping all over India, and labour was being discharged. This showed that capital was leaking away from the country, as he and others predicted many years ago. Wherever he went, and spoke to the planters, he heard of mortgages being foreclosed all over the country, simply because capital could not be obtained. It might be supposed that this state of things was owing to the great fall in the price of coffee, in consequence of the over-production in the

Brazils; but it could easily be seen that this was not so, because, in 1885 and 1886, a similar decline in price occurred for the same reason, but it was not followed by the decline in labour or withdrawal of capital, or the disastrous signs now existing. He estimated lately that the withdrawal of labour from this industry in India last year, as compared with the year before, was about 68,000 or 70,000 labourers; and Ceylon being similarly situated, there had probably been a decline in the two of about 150,000. As the famines in India were increasing, people were being more and more thrown out of employment. Why did the capitalist, who came forward readily in 1885-6 to help the producer, now button up his pockets? It was all due to the currency policy of the Government. It was not seen at the time that that policy was really an attack on real property, and also to a large extent on personal property. The moment that Act was passed, the possibility of making as much profit as before declined, and the capitalist who lent money on the security of coffee plantations saw that his security was on a totally different footing. Formerly it stood on an automatic currency; now it was swept into the exigencies of Indian finance, and what those exigencies must compel the Government to do, in the face of these famines, no one could tell. If the exchange was forced up in the way it had been, it might be forced up again; and if that were so, mortgages made to day on one basis would be altered to-morrow. The capitalist seeing also that the producer was handicapped in competition with producers in other silver-using countries to the extent of 25 to 30 per cent. refused to make advances, and labourers were discharged. He had also made inquiries of a gentleman connected with gold-mining as to how that industry was affected by the forcing up of exchange, and he informed him that he estimated that for every 1d. that exchange was forced up, the mines with which he was connected lost £31,150 per annum up to 1898; and as their operations had since increased, the figures would be much larger to-day. If time allowed, he could follow up this point at some length, but he hoped it would not be overlooked. It seemed to him evident that if we wish to promote Indian industries, we must either return to our former automatic currency, or grant bounties in favour of the Indian industries which compete with those in the other silver-using countries. Failing one or other of these remedies, Indian industries must decline.

Mr. N. B. WAGLÉ said that he was a firm believer in the doctrine that India could not make any progress amongst civilised nations unless her industries were properly developed; and he might claim to have put his shoulder to the wheel and taken some part in the work. If he achieved any success in the undertaking he had embarked upon, it would be due to the help he had received from his friends, the Honourable Justices M. G. Ranade and E. T. Candy, in India, and was also receiving in this country from Sir M. Bhownaggree, and one of the greatest friends and well-wishers of Indians, Sir George Birdwood. He could not agree with the optimistic tone of some parts of the paper with regard to the industries of India. The agricultural industry even, did not mean more than the cultivator going to the fields at a time which an astrologer would find out for him, tilling the land once, and then waiting for Providence to do the rest. The test of learning in any country was the books it could sell or publish; and in like manner, agricultural progress was indicated by the demand for manures and agricultural implements of the newest design. This demand in India was quite absent, and they could not say, therefore, that agriculture was progressing. It was the same with regard to other pursuits, such as factory enterprise. No industry could progress unless those engaged in it enjoyed the esteem and consideration of their fellows; where this was wanting the occupation would die out. Now, at present, Indians had not that respect for industrial pursuits which was necessary to their success, as he could show by his own experience. He was working in a glass factory, and was always pleased to take his friends, especially those from India, to see what he was doing. On one occasion, he took such a friend, who seemed much interested, complimented him on the work, and said it would be a great help to India. After discussing where the factory should be located in case he succeeded in establishing one in India, he asked his friend on his return home to send him over samples of sand for analysis, to see if anything could be done with them. He thought, from the conversation, that his friend sympathised with his object, but eight months had elapsed and he had received no samples, only messages of kind regards. The next incident was even more interesting. He took another friend with him to the factory, took off his coat, showed him how he worked, and made several little articles in glass. His friend praised the work, said it would be a great benefit to India, and so on, but he could see he wanted to say something else, which he hardly liked to. Ultimately, he asked him what he was keeping back, and at last, he said, "My dear friend, you must remember that you are a graduate of a University and a Brahman, and the way in which you work in your factory must certainly lower you in the eyes of the British people, and not only you, but all your fellow-countrymen." That, he feared, represented the opinion of the present rising generation of his countrymen, and until this was changed, and a respect for industrial pursuits was inspired in the mind of the people, they could not expect to raise the country in the scale of civilised nations. He fully appreciated the attempts made to obtain an elaborate and perfect administrative system for India, but in order to get rid of poverty, and really to do anything substantially to benefit India, they must introduce wealth from without. The best possible Government could only regulate the wealth in a country,

nd help to distribute it properly; it could not add o it. It was a great economic truth that that nation, hat race, that community, that individual, would be rosperous which got possession of trade. England vas an instance of a nation, the Jews of a race, the Parsis of a community, which illustrated this point. This work could not be thrown on the shoulders f the Government, nor could the blame for neglect of t be laid on the educated classes, or on the workmen. The work must be divided between them all. He ould not find fault with the workmen; there were no etter, steadier, or more manageable workmen than ou found in India. It was the duty of the educated lasses, even if they did not conduct the operations hemselves, to combine their resources, to organise nd provide the machinery for bringing capitalists nd workmen together and starting new industries. ndian capitalists, with very few exceptions, such as Ir. Tata, or the late Mr. N. N. Wadia, whose loss hey still mourned, were not up to the mark of their Vestern brethren. They were mere men of money, nd without enterprise. It was the duty of the Government to encourage enterprise, and to start suitble enterprises where there were none, because from ncient times Indians had been habituated to look to the Government, in all matters, for patronage. The caste ystem might be an evil in some respects, but he ighly appreciated what had been said about it in the aper. It represented the skill of the workmen, which ad been accumulated by an hereditary experience of t least 3,000 years, and it had preserved the ancient ndustries of India under overwhelming difficulties. But modern influences had thoroughly undermined hat system, and unless they could support this reat bulwark of the country by the prop of modern rogress, the whole organisation would break down n irretrievable ruin. He would, therefore, present his question for the serious consideration of his ountrymen, with the words of the poet, "Awake! rise! or be for ever fallen."

Mr. L. R. W. FORREST said, with regard to he pressure of population on the land, there vere in the Bombay Presidency 24,000,000 acres f arable land, and it was said that 23,000,000 vere already cultivated, so that there was not nuch scope there for increase. There was an old roverb, Blessed is the man who causes one blade f grass or wheat to grow where none grew before; ut he would say that twice blessed was he who nade two blades of wheat grow where there was one efore. That was the important point—the area of ultivation was limited, and every effort should be nade to increase the productiveness of the soil. It as pitiful to see thousands and thousands of tons of ost valuable manure leaving the country; the ryots ade no use of it, though the produce might be oubled or trebled by the use of fertilisers. The otton industry was just now suffering a most terrible rain from the failure of the crop, which was only bout one-tenth of the average. Few realised what that meant, and the Government, probably from the fear of Manchester, paid no attention to the trade; the excise duties of $3\frac{1}{2}$ per cent. still remained, the idea probably being that, as the mills were losing so much, an additional $3\frac{1}{2}$ per cent. made no difference. There was no doubt that of late years, thanks to the India Office, the Government had paid more attention to the purchase of stores in India. He read in the papers that the India Office had lent a large portion of its Store Department to the War Office, and he could only hope that the noble lord, who presided over Indian affairs, would leave them there. A gentleman had said to him only that day that the Store Department had done more to prevent capital going to India than almost any other body. In former years, no doubt it was necessary to procure stores in England, but now there was much less need for the Store Department. No allusion had been made to the cultivation of silk in India, in connection with which Sir Thomas Wardle had done so much. He did not think that the Society of Arts could do much for the industrial development of India, or the improvement of the condition of the poorer classes, but capitalists could do something in the exploration of its mineral resources, though he had not much hope of that until the Government of India changed its mode of looking at promoters and speculators. That attitude would be described in the words of an official, who said he absolutely detested the name of promoters. He could quite understand it, because the Indian officials were accustomed to do their duty without looking for any extra reward, but the promoter and exploiter naturally looked for a good remuneration for his work. He did not say this was the attitude of the India Office, which was partially affected by London influences, but it was that of the bureaucracy—the Indian Government; and if any development in the exploitation of minerals was to take place, it must adopt a different attitude towards those who were willing to come forward and spend time and money in trying to discover minerals. In Australia, if a man discovered a gold-field he was rewarded by the Government, but they were a long way off anything like that in India. He had spent thirty years in India, and felt that the Government had not done what it might to assist capitalists and financiers in developing the capabilities of the country.

Mr. H. M. BIRDWOOD, C.S.I., LL.D., felt sure that, in the judgment of the meeting, Mr. Baines would not escape the imputation of extreme modesty when he told them, as he did at the outset of his paper, that he had set himself to do no more than "open a discussion" on the great subject to which he had addressed himself. Mr. Birdwood would have imputed to him undue modesty, were it not for his inability to agree with the dictum of an eminent American, who held that, though modesty was a good thing, most people got on better without it. In spite of his modesty, Mr. Baines had

got on very well indeed with the very effective and suggestive paper, to which they had all listened with so much pleasure. Now, if Mr. Baines, with his unrivalled knowledge of facts, and his scholarly power of terse and happy expression, had been able, in three-quarters of an hour, to present only certain general considerations with reference to the industrial development of India, how hopeless must be the case of the speakers who followed him, who were bound by the unwritten rule of brevity, which had always found so much favour with the audiences assembled by the Society of Arts in that Hall, but which was very difficult for speakers to comply with, not in that Hall only but in another place also, as had been proved by a recent debate. If Mr. Baines had but touched the fringe of the outer covering of his subject, he (Mr. Birdwood) could, under the five minutes' rule specially applicable to himself, lay hold of but a tag or two of the fringe. However, though the time was short, it would suffice for him to express his cordial concurrence in two of the conclusions, at all events, at which Mr. Baines had arrived. He agreed with him in all that he had so well said about the peasantry of India,—the patient, law-abiding, industrious, and loyal peasantry, who had suffered so grievously during this present year, and were bearing their great troubles with noble heroism. Mr. Baines had rightly described our Indian Empire as a peasant empire, and pointed out that the tastes and requirements of the vast rural masses were the chief factors in the industrial development of the country, and that it was by the verdict of the peasantry that the reputation of our administration must stand or fall. We may well be happy that that verdict is in our favour. An old Rajput peasant of Kathiawad once made the singular remark to Mr. Percival, when he was Joint Administrator of the Bhavnagar State, that, if the Indian ryots were dissatisfied with British rule, nothing could be easier for them to get rid of it by each one throwing a clod of earth at every British officer he met, and so overwhelming our whole administrative staff beneath a mighty load. That remark was undoubtedly the outcome of a good deal of patient meditation on the character of the British rule. On the whole, this shrewd old peasant was fairly well satisfied; and so was the great mass of the rural population, not only with the general results of our administration, but with special efforts also for promoting their welfare. They were grateful for the regular administration of justice, for a considerate revenue administration, and for much else that we have done, but, most of all, for what we have refrained from doing. We do not worry them with interference in the daily affairs and occupations of their lives, which they are at full liberty to carry on according to their ancestral methods; and they are, therefore, all the readier to adopt new methods that we may bring before them, when once they realise the advantages to be derived therefrom. In the neighbourhood of Poona, as he could say from personal observation, the accomplished and enthusiastic Deputy-Director of Agriculture, Mr. Mollison, had, by steady and long-continued demonstration of the excellence of his own methods, been able to teach the peasantry a good deal that was new to them—as to such matters, for instance, as the proper rearing of cattle and live stock generally, the management of dairies, and the production of good and wholesome butter, and the better and more remunerative cultivation of particular crops,—such as potatoes and sugar cane. And his lessons had borne good fruit. The example set in the Government farms had been followed with advantage by many cultivators throughout the whole country-side; and there could be no question that an impetus had thus been given, in many similar centres, to a movement which would tend to materially develop the intelligence and prosperity of the people. He would say only one word more. He agreed with Mr. Baines in the remark at the close of his paper, that industrial development, to be sound and permanent, must follow the natural course. It must not be forced on the peasantry from outside. It must grow from within. To use a botanical term, it must be exogenous, a development from the centre outwards. We must rely on influences which we have ourselves set in motion to produce that general growth of intelligence which would lead the people to realise more fully their real wants, and to take the best means for meeting them. We had given the people the steamship and the railway, and "the thoughts that shake mankind." The inevitable result can be awaited with patience. The rule in this, as in so many other cases, must be to "Make haste slowly."

The Hon. J. D. Rees, C.I.E., said it occurred to him, in listening to the paper, that there was one practical thing which could be done towards the development of the industrial resources of India and that was not to interfere by legislation with the system of labour which had grown up, any interference with which was injurious. Mr. Baines had referred to the family system, on which all labour in India was based, but that was forgotten, and slipped out of sight in legislation on the Western individualist pattern. During the last session in Calcutta it was his good fortune to be a Member of the Select Committee appointed to deal with the question of labour in Assam, and he remembered the severe criticism that was directed against the rate of wages paid in Assam, founded on the fact that a wage of five rupees was given to an individual. But you could not gauge the earnings in that way, because while the man got five rupees his wife got four, and the children two or three or so between them, and thus the family had sufficient to live upon. In the Central Provinces again the whole organisation of famine relief was based on the family system; the man got $1\frac{1}{2}$d., the wife 1d., and the children between them 1d., and they had ample to live on. So far from the Government being "helpless in the face of this great calamity," as one of the speakers had

id, he must confess that he was struck with s preparedness and equality to the task. On the aipur relief works there were 40 per cent. of the eople, and nothing was more striking than the fact at they were all maintained in fair condition in the ost stricken districts of the Central Provinces, here the famine was most severe. If any body ere put down in Raipur, in the heart of the mine district, he would be unable to distinguish those ho were employed on relief work by the Government, om those who were not. During the Budget debate, e expressed that opinion, and he was corroborated by n officer who had written to the Viceroy from aipur. He thought it was just as well to menon these facts, showing the extreme efficiency f the arrangements, and the admirable manner in hich the Famine was being met. This was very uch overlooked, and when subscriptions were called r the appeal was sometimes misinterpreted. It was ot that anybody was sent away hungry, because obody was; everybody who came was given pay— r work if he could do it, and without work he could not. It was for providing additional omforts for the sick and caste-ridden, and to elp the agriculturists, who had lost their cattle, at subscriptions were asked, and there could e no better cause. But people in England ould not think that their subscriptions were emanded to feed the people whom the Government were sending hungry away. There was considerable migration from the famine disicts to Assam, and he hoped nothing would ke place to check that. There was another ill with reference to mining, which came this year efore the Council of the Governor-General. Mr. orrest had referred to the restrictions which existed n the transfer of concessions, and he could assure m that they were being reduced, and in future ansfers would be more easy. What he partly wished say on this subject was, that legislation on mining ust also be based on the family system. If children elow a certain age were not permitted to enter a ine their parents could not go either. If the man ent the wife must go; and if she went, there as no maid servant to attend to the children, they ust go also. They were all happy below, and there as no need to interfere with them. As Mr. Elliot ad referred to the tea and coffee industry Mysore and Travancore, and to capital leaving e country, he might say that a million sterling ad quite recently been put into one group of estates Travancore, but that Government assistance in at State was far behind private enterprise.

The CHAIRMAN said it was now his pleasing duty ask the meeting to pass a vote of thanks to the ader of the paper. Those who took an interest in dia could not find any subject more worthy of tention than how to develop the industrial systems hich prevailed there. They all deplored the terrible mine which existed in Western India, and the privations to which the agricultural classes were subject, but they must never forget that this terrible disaster was not merely a food famine but also a wage famine, and he believed that in that aspect it pressed even more heavily on the people. There was always, as far as they knew, sufficient food existing in India for the people, if it were adequately distributed, but when it was remembered that 80 per cent. of the population were dependent for their means of existence upon one industry, and that one industry failed whenever there was a drought, there must be terrible distress in the districts affected. It was, therefore, a primary duty of the British Government to do everything they legitimately could to try and multiply and diversify the industries of India. There was no justification for the trust which we had undertaken in connection with India unless we were able to improve the material and moral condition of the people resident in that continent; if we failed in that duty we struck at the very ground-work of our claim to authority. The discussion had branched off into several subjects, and he would deal first with the one on which Mr. Elliot had expressed himself with great force, to the effect that the cause of the failure in India was the pernicious currency policy which the Government adopted. It was a curious fact, if Mr. Elliot went to Ceylon, that he did not ascertain what the condition of that country was, because by the absolutely unanimous reports Ceylon never was so flourishing as at the present moment. Its revenue had increased by leaps and bounds, and the people ate more, and paid more taxes than ever. Yet the system of currency was exactly the same as in India. The fact was that gentlemen who, like Mr. Elliot, were engaged in the export trade were a little too apt to look at the currency question from their own standpoint. A falling exchange for the time being was a benefit to the exporter, because a falling exchange meant a rise in price, and there was always an interval between the rise in price and the rise in wages, of which the exporter got the benefit. He paid his men at the old price, and got the higher price for the article exported. But one could see at once that in course of time, assuming the exchange remained at a fixed point, wages rose, and the exporter got no benefit. Therefore, for a fall of exchange to be a benefit it must go on falling and falling, and he would benefit more when it was 11d. than when it was 14d., and still more if it fell to 8d., and ultimately he would be benefited most of all when it came to nothing. He made allowance for the difficulties which exporters in India were subject to; but if Mr. Elliot studied the financial and currency systems of the world, he would not find a single instance where any great community benefited by having a depreciated currency in circulation. So far from preventing capital being invested in India, it was the absolutely universal opinion of all capitalists and bankers in this country, that if you could only secure stability of exchange within certain

limits, you would at once remove what had been the great obstacle during late years to the investment of British capital. There were two industries to which Mr. Baines had alluded, the cotton and jute industries, and there were two incidents connected with them which would encourage them, and especially Mr. Wáglé, whom he congratulated on his enterprise, and on the courageous manner in which he was trying to establish a new industry in India. The cotton industry was, in one sense, established almost by accident in India. It was largely a consequence of the failure of the supplies from America owing to the Civil War, and the inability of other parts of the world to obtain the raw material they had previously got from the States. That condition had passed away, but the Indian cotton trade still held its own well in competition with the cotton trade of the world. The jute trade was brought into existence by a similar accident; the failure of the hemp crop in Russia, which led people to devote attention to growing jute, and a great industry sprang up which had held its own with all competitions. They might clearly come to the conclusion, therefore, that if persons of enterprise, capital, and courage, had chosen to establish cotton mills in India, even if the American Civil War had not occurred, they would, in course of time, have been able to make them pay. Mr. Forrest appeared to think that one of the great malefactors who prevented the increase of the Indian industry was the Store Department of the India Office; but he thought that view was incorrect. There was a certain number of gentlemen who were paid fixed salaries, and however fond people were of doing work, they did not often go out of their way to double the amount of work they had to perform. If it were true that there were all these manufacturers in India who could supply the articles required, there was no Department which would be more pleased in making that discovery than the Store Department, because they would simply retain their salaries and have less work to do. Orders had been given for placing contracts in India wherever feasible. Allusion had been made to the great development of the leather trade, and he hoped this war might still further develop it. Owing to the tremendous demand for saddles and other articles, immense requisitions were sent to India, and she supplied a very large number of saddles and equipments of one kind and another, and he believed the leather so supplied was of excellent quality and giving general satisfaction. Some of the skins were somewhat slighter in texture than those in colder climates, but the work was good, and Lord Roberts told him, when he explained that certain contracts had been placed in India, that they could not get better saddles or better leather than were supplied there. Mr. Baines and other speakers had commented on the fact that there was not a disposition on the part of the native capitalist to invest his money in new industries; but there he felt that possibly the English Government was, in one sense, to blame. It had placed the money-lender, who advanced money on land, in a better position than he had ever occupied before. It gave him a security which he never had before, by the low land assessments, and the facility of recovering his money through the civil courts, and in addition to that, the reign of law and order and peace made his avocation mnch easier. Many years ago, when he was first associated with the India Office, the political economists of the day informed him that all these beneficial operations would benefit the cultivator ultimately, as he would obtain his money so much cheaper than before. He was rather doubtful if that had been the case, and so long as those who advanced money on land could get such a very good return, it was not likely they would be disposed to put their money in a perhaps more risky business connected with new industries. When the last famine was over he was very anxious to ascertain whether the increase of population in India generally had pressed much on the means of subsistence, and whether the general condition of the population had improved in the twenty years which had elapsed, and he was fortunate enough to get Sir James Lyall to undertake the duties of Chairman of the Finance Committee, which went round and investigated what had been done in the various districts, and obtained evidence. It was a small Commission, comprised of very competent gentlemen, and they got evidence from witnesses on whose recollection all the horrors and distress of the recent famine had been impressed, and, therefore, their tendency would have been, if anything, to exaggerate, rather than minimise, the condition of the people amongst whom the famine had prevailed. But they unanimously reported that during the twenty years the agricultural classes in those districts had improved their material condition, although they doubted if thrift had increased amongst them to a corresponding degree. They also said that as regarded the artisan and commercial classes, who were not very numerous, there was also an improvement. They said that amongst 80 per cent. of the population there was an improvement in their condition as shewn by their clothes and household equipment, but they ended with the significant words that there was a large residuum which had increased faster than any other part of the population, that it was becoming more and more susceptible to local famines and sudden pressure, and that it was doubtful if during the past twenty years their wages had risen to a degree corresponding with the rise in the necessaries of life. There was no problem more difficult, or which gave one greater anxiety than the question how for the future they should be able to provide for this ever-increasing population conditions which would secure to them a living wage. He saw no hope of attaining that object unless they could increase and multiply industries. He recognised the energetic steps which Sir M. Bhownaggree had taken to modify the exclusively literary character of the higher education given in

ndia, and to associate with it a practical and technical side. He believed the currency policy recently dopted would tend to more capital being placed in ndia, and also attributed some importance to the act that the great motive power of the future was lectricity. The great rivers of India would supply lmost unlimited power, and electricity had this normous advantage, that whereas steam as a motive ower tended to aggregate people in factories, and multiply the same products over and over again, lectricity could be split up and taken in small units o different houses, and this gave the handicraftsman who was clever a motive power which might tend in arious directions to revive some of the older industries in metal and wood. Above all there was he universal feeling of sympathy and sorrow which revailed amongst all classes of the community of ndia, for her present sorrow and suffering, and of dmiration for the courage and fortitude with which hat visitation was being borne. He hoped that even hat discussion might do something towards accelerating the end they all had in view.

The vote of thanks having been passed unanimously,

Mr. BAINES acknowledged it, and said that it would probably be more convenient if he were to eply to the questions raised in the discussion through he medium of the *Journal*.

Mr. BAINES writes :—As the object of the meeting was to discuss the subject rather than my reatment of it, all that remains for me is the ask of briefly bringing the main arguments into heir bearings as regards the general question. This uty is not unnecessary when experts are called n, since they are apt to dwell somewhat exclusively n the aspect in which the case presents itself to their pecial interests. That veteran controversialist, Mr. Elliot, for instance, seems to ignore such factors as lant disease, and the prosperity of trade in other roduce than coffee, in order to enforce his pinion of the currency policy of the day. The ttitude of his school in fact reminds me of what Burke said of the anti-emancipationists of his ime, that, "to make room for the vices of Papists, hey clear the house of all the vices of men." Similarly with the gratifying and touching confidence xpressed by others in the beneficent influence of he State upon industry. The Government may, it eems to me, legitimately take all advantage f the Indian market wherever the quality of the rticle produced there is equal to, and the price not bove, that of the foreign-made goods. On that onsideration I procured all the paper used for the ensus, some hundreds of tons, from local mills. The ron works, again, in Bengal trust, I believe, almost ntirely to State demand for their custom. But to go urther than this, to create and maintain industries which would otherwise not be in existence, seems to me to be unhealthy and inadvisable. Then there is the question of the impediments placed by the State upon "promoters," impediments which Mr. Rees tells us are being diminished or removed. I have been witness, however, of certain phases of promotion which do not detract from my appreciation of moderate caution on the part of the Government. There are promoters and promoters, and enterprise often means no more than prospectus writ large. A few more Bengal gold mines will set the barometer at suspicion for another generation, so far as Indian capital is concerned, and, as I have said in the paper under discussion, the influx of foreign capital, good as it is, only defers the day of settlement of the main question. It is development, rather than exploitation, of Indian resources that should be kept in view, and, *pace* Mr. Wáglé, the capital absorbed by India is ample for the former, if only the proper tap can be inserted. His own example must have our full sympathy, but its benefit will hardly be wide enough if he merely supply good wares in substitution for the coarse work of the glass-working caste. It is hoped that he will operate through that caste, and disseminate in their villages a knowledge of the better processes he has introduced. On this subject of village technical instruction I do not go quite so far as my friend Sir Mancharji. I fear that a general system of school training, such as he contemplates, is in advance of the time and alien to the spirit of the village. If successful in attracting pupils, it might—I don't say it would—tend to raise up a set of State-trained artisans, even as in the towns there has been raised up a literary proletariate, sitting at the door of every Government office, with the wail, "You have filled my head, now fill my belly." What I had in view was the establishment of a training agency in a few representative villages, as part of the community, leaving the results of the teaching to radiate outside the village, partly by dint of appreciation of the better work, partly through the opportunities afforded by caste gatherings and weddings of exhibiting and advertising the new departure. The pivot of the whole economic situation is, of course, the demand of the peasant, and the question is how to stimulate this and make it effective. In the first place, there is, as Mr. Forrest says, the need of intensification of production from the present cultivated acreage, though I venture to think that the arable area is not yet under cultivation to the extent he suggests; but the waste of fertilising material is, as he says, deplorable. On the other hand, the example of what took place in the Panjab as regards the irrigation of wheat, and similar experiences with cotton and other crops indicate, as Mr. Birdwood points out, that the peasant is perfectly willing to take advantage of experiments conducted at the expense of others, and conclusive in their results. His methods are, moreover, by no means as primitive as Mr. Wáglé, who, as a Brahman and a coast dweller, has but slight and superficial acquaintance

with the soil, is inclined to think. The peasant is improving, and will be inclined to make quicker progress as his opportunities increase with his needs. But it is not to be supposed for an instant, as has been suggested, that either higher cultivation or diversion from the soil is put forward by any sane observer as the preventive, still less as the remedy, of famine. Even assuming, which I do not, a very material increase in the proportion of artisans to cultivators, the latter must always constitute the chief market to which the former have to look, so that a loss of crops affects the artisan with the cultivator, except to the extent to which he has been able to establish a non-agricultural *clientèle*, a factor not at present considerable. Indirectly, however, and slowly, the diversity of occupation works for good, both for peasant and artisan, inasmuch as it suggests and opens directions in which money can be spent other than those sanctioned by tradition and by the public opinion of the present day. Mr. Wáglé deplores the decadence of the caste system under modern influences, but I confess that whatever modifications and mitigation of certain features and practices may have resulted from contact with Western civilisation, I fail to see that the system is anything but what it always has been, or that it has lost one jot of its original hold upon the popular sentiment. In a few minor respects it has adapted itself, on grounds of everyday convenience, to modern requirements, and it is in this adaptability that it finds salvation. In all essentials it stands firm, and in none more than in the burden it imposes of unproductive expenditure at social functions, such as weddings and funerals. So long as these constitute the only outlet for the vanity inherent in the Indian as in us all, financial success will measure itself by that standard. The appreciation of other ways of spending money as opportunities are offered tends towards the curtailment of the old practice, and concurrently the adjustment of individual preferences which may ultimately develop into the rudiments of thrift, or that provision for a droughty day which alone can cope with the effects of the failure of crops. This, however, is a moral advance which must wait upon the improvement of material circumstances—

> "Men's judgments are
> A parcel of their fortunes, and things outward
> Do draw the inward quality after them."

Mr. A. Rogers writes:—Having been unable to speak at the meeting on May 17th, to hear Mr. Baines's paper on "The Industrial Development of India," I now write to suggest a few practical ideas on the subject. None of the speakers touched on the point of what old industries there are which could be revived, or what new industries could be introduced, and it is as well that an English audience should be informed that there are both in existence, in order to show to what permanent use some of the subscriptions which are now being given for the relief of the temporary wants of the people could be turned, and thus mitigate the evil effects of future famines, whic from climatic causes, must periodically recur. Thre fourths of the population, as Mr. Baines remarke being engaged in agricultural pursuits, India may said to be a country of virtually a single employme All its eggs are in one basket, and if that bask breaks, as it has in many parts in this famine, gre sufferings must ensue, for which the only reme to be found lies in fostering additional industr to which people may turn their attention to gai livelihood. Now that railways cover the surface the country, and enable the surplus produce of o part to be conveyed to others not afflicted by su calamities, there is practically no possibility of a r food famine. It can only be one of the means purchasing food, to be remedied by the distributi of wages. No one can, from personal knowled speak of what industries can be fostered througho India. It is, therefore, advisable that everyone shou suggest them for the part of the country which himself knows. I accordingly take the Province Gujarát, in the north of Bombay. The collecti and curing of hides, mentioned by Mr. Baines, of course, common to all India, and I would a the making use of horns and hoofs of cattle for t manufacture of ammonia, &c., and of bones for ph phates, as evident sources of profit and of extens employment for the people. In addition, there three peculiar to the Province itself—viz., the cult of *tassah*, or wild silk, the manufacture of glass, a the development of mineral resources. With reg to wild silk, the variety of the silk-worm call the *Antheræa Mylitta* abounds. Specimens of t cocoons in my possession have been pronounced Sir Thomas Wardle, one of the best authorities England, to be of exceptionally fine quality, and the Bheel and other women in the famine-strick districts had been able to reel the silk, one half of t evil effects of the present famine would have be avoided. I hear the Gaikwár, to whom I have writt on the subject, for Gujarát, is making experime near Songarh, on the Tapti Valley Railway, and hope that if these succeed, the industry, which is n in the Province, may be extended throughout Glass is already made at Kapparvanj, in the Thá Talúka, in Kaira, from a surface effloresce of carbonate of soda and the silica with whi it is mixed, but as the materials are crude a impure, the glass produced is naturally very coa and bad. It is used mostly for women's bang and rough glasses and bottles, but if the sodiu salts were refined, and a finer sand (derivable fr fine granite, to be found at no great distance) use there can be no doubt that glass of much better quali could be manufactured and a valuable local indust created. The development of the mineral resourc of the country would provide most extensive emplo ment in certain parts, and would not be entire new, although from the absence of coal and the e haustion of forests whence to procure charcoal, has, probably for several hundreds of years, fall

ɔ disuse. I have found iron slag scattered over ge tracts of country in the Nárúkot district, testiıg to the extensive use in former days of the large ɔosits of fine hæmatite iron ore I have lately recovered. It was probably smelted in small quanes for weapons and agricultural implements in ırcoal fires. In the same neighbourhood I have ınd rich manganese, of use for converting the iron o steel, slate for roofing and flooring, and mica in form of talc. Vast veins of quartz will probably found to contain gold. These deposits are not uated in British territory to which the mining es of the Government of India would apply, but territory under the administration of the Political gent in the Reva Kánta, and the Bombay Governent in endeavouring to act up to the spirit, if not letter, of those rules, have adopted provisions ıich will have the effect of deterring, and not couraging the introduction of capital for the delopment of the resources of the country. I have eady addressed the Government of India on the oject, and hope to see more extensive powers given the local Governments to modify the rules so as meet different circumstances. There is ample ɔm in Gujarât alone for an exploration company, ıich would provide capital for the discovery of local ırces of profit and the development of local instries as additional baskets for the eggs of the ıntry, and there could be no more admirably ıritable use to which the surplus funds of rich ıgland could be devoted than such development for benefit of the people of poor India.

Miscellaneous.

CITY AND GUILDS OF LONDON INSTITUTE.

The annual report of the council of the City and ilds of London Institute, which has just been ued, states that at the invitation of the Comssioners of the University of London the executive nmittee of the institute had accepted the position "a school of the University" for the Central chnical College, and the college was included in first list of such schools in Clause 82 of the atutes. Four of the professors and assistants of Central Technical Institute had been named by Commissioners as members of the Faculty of gineering, and six as members of the Faculty of ience, Professors Ayrton and Unwin being named members of both faculties. It was mentioned by council as an interesting fact that a number of institute's students were at present engaged with forces in South Africa. Eleven students of the ntral Technical College, of whom six were in ual attendance, volunteered and were accepted for ive service, and one was called up to serve with his litia regiment. During the session of 1899-1900 council conferred the Fellowship of the institute on Mr. W. J. Pope for the large and valuable amount of original research work carried out by him since he gained his Associateship in 1890, and on Mr. A. E. Childs, on the ground of the services he had rendered in developing several new branches of engineering industry since he gained his Associateship in 1891. At the Central Technical College there were at the last winter terms 272 students, of whom 115 took the civil and mechanical engineering course, 94 the electrical engineering course, 24 the chemical course, and 39 the special course. At the close of the session the diploma of the institute was awarded to 39 matriculated third-year students. The executive committee were in negotiation with the Royal School of Art Needlework for some rooms in their new building to enable the institute to provide additional accommodation for the electrical engineering department. The gross amount of fees received from the students during the year was £6,797, of which £467 was remitted in the form of studentships. The cost of the college in excess of the amount received from students' fees was £5,813. At the Finsbury Technical College in the last session there were 180 day students as against 185 in the previous year; and the evening classes were attended by 649 as against 760. The diminution in the number of students in the "trade classes" was due partly to the fact that similar classes were now organised in all the London polytechnics, and partly to the arrangements to transfer this department of the college to the Hoxton Institute under the Technical Educational Board. The report also contains some interesting remarks as to the progress of the South London Technical School of Art.

JUTE STATISTICS.

In the year 1795, Dr. Roxburgh, the distinguished botanist, then residing at Sibpore, Calcutta, showed a bale of fibre prepared by himself from the stalk of one of the two species of jute plants. The fact that Dr. Roxburgh first used the word jute to indicate Jhot, the most popular vernacular name for the fibre in Bengal; and the way in which he used it, "the jute of the natives," suggest the idea that he got it from the people about him in the botanical gardens at Sibpore. These people were most likely the Mallies (gardeners) employed at the garden, and who, as a rule, are natives of Orissa, and since Jhot is the prevailing name for jute in Orissa, the inference is that Dr. Roxburgh got the word from his Orissa mallies, and that Europeans have since followed him in using the word. The cultivation of jute is stated to have been going on in small quantities for local requirements from time immemorial. In Norvgong it is stated to have been known so far back as the last decade of the 15th century, when the use of the fibre for tying up books was expressly prohibited by Sunkar and Madhow. According to reports from

district officers and reliable old inhabitants, the cultivation of jute has been carried on more extensively in the district of Bogru (Rajshaye Division), 208 miles from Calcutta, since the year 1847, and in the districts of Tipperu and Noakhali (Chittagong Division) since the year 1854. Nymonting and Rungpore are the two largest jute-growing districts in the whole of India, the former in the Dacca Division, and having a population of nearly $3\frac{1}{2}$ millions, and an area of 6,322 square miles, equivalent to 4,052,480 acres, out of which 550,000 acres is under jute cultivation, and a little over 2,400,000 under rice, the greatest rival of jute. The remainder is under various other produce. The latter district (Rungpore) is bounded on the east by the river Brahmaputra, which separates it from the former district (Nynomsing). It has a population of over two millions, and an average acreage of 272,000 acres under jute. The cultivation in these two districts has been gradually spreading since the year 1849, but the extension has been specially notable there since the cultivation of indigo was abandoned in the former, and immensely curtailed in the latter district.

The jute of commerce is obtained from two different species of plants, both belonging to the same natural order—*Tiliaceæ* (elm or linen tree group). The order embraces several genera, the bark of which yields fibres; but of these the genus *Corchorus* is the most remarkable, as including the two species of valuable fibre-producing plants from which the entire jute of commerce is obtained at the present day. It is an annual plant, growing five to ten feet high, sometimes higher, with a cylindrical stalk as thick as a man's finger, and seldom branching, except near the top. The leaves are of a light green colour, about four to five inches long, and about one and a half inch broad at the base, but tapering upwards into a long sharp point at the apex. The edges are cut into teeth, the two teeth next the stalk being prolonged into thread-like points. The flowers are small, and of a whitish-yellow colour, in clusters of two or three opposite the leaves. The seed pods are short, globular, wrinkled, and rough. The other plant is precisely similar in general appearance of the plant, shape of leaves, and habits of growth; but it differs entirely in the formation of its capsules or seed pods, which, in this species, are elongated (about two inches long), almost cylindrical, and about the thickness of a quill.—*The Textile Mercury.*

PRINTERS' EXHIBITION IN GOTHENBURG.

According to the United States Consul at Gothenburg there will be held in that city, from July 15th to September 1st next, a printers' exhibition, which is expected to be of great interest not only to printers but also to the public at large. Besides rare and unique books, prints, &c., which are of value especially to printers, the exhibition will embrace articles of interest to everybody, such as artistic book covers, original drawings by Swedish and foreign artists, an a collection of all kinds of products of the graphic ar woodcuts, engravings, etchings, &c. This exhibitio will be the first of its kind in Sweden. Contribution are expected from foreign as well as from Swedis publishers, printers, bookbinders, libraries, artists, an private book collectors. A feature of great intere will be the expected products of Persian, Servian Turkish, and other Eastern book industries. It intended that the exhibition shall offer a compre hensive review of the printer's art and its develop ment from the beginning up to the present time. Th greatest attention will be paid to the present conditio of book printing, and it is intended to show a print ing office in operation, and for this purpose an agree ment has been entered into with a machine firm whic will send a collection of presses for common boo printing, for coloured prints, and illustrations; als folding machinery, paper cutters, pamphlet binders, type-setting machine, and a type-moulding machin It is also intended, if possible, to illustrate the progres of the art by exhibiting a printer's shop of the Middl Ages, and a paper factory producing hard made pape All inquiries and applications should be addressed t "Svenske Bokindustri-Ulställningen i Göteborg 1900."

AUTOMOBILES IN GERMANY.

The automobile industry, though still in its in fancy in Germany, is being rapidly developed, and in the opinion of the United States Consul at Leipzig is destined before long to become an important facto in the manufacturing industries of the country. Th large amount ot capital and energy which is bein expended upon this branch of industry indicates tha German business men have great confidence in th future of automobilism. Last year there were abou 1,000 men employed in and around Berlin in th automobile industry, and it is expected that thi number will be more than doubled during the presen year. In France, the results which have been aime at for the most part have been to obtain excellenc in sporting and luxuriantly-appointed automobiles while in Germany just the opposite state of affair has existed, the manufacturers have given mor of their attention to making motor vehicles fo the carriage of goods—not without success either, a was shown at the International Motor Waggon Exhibition which was held in Berlin last year. Fo motive power, electricity and benzine are almos exclusively employed; the use of steam power is a yet hardly out of the experimental stage; the sam may be said of the employment of compressed and liquified air and of combined systems (benzine and electricity, &c.), the advantages of which are offset by a too complicated mechanism, and the great amoun of attention which is necessitated thereby. Electricity as a motive power has a strong competitor in benzine The employment of the electromobile depends upon the nature of the lead accumulator; the great weigh

of this metal increases the weight of the motor to such an extent that the electromobile can be used to advantage only in carrying persons and light loads on good roads with easy grades. The electromobile necessitates the establishment of charging stations. It is well adapted for omnibuses in cities with electric light plants and good streets, and also for delivery and other motor vehicles. The electric automobile seems to be preferred to the benzine automobile on account of its much simpler mechanism, less noisy running, and absence of the unpleasant odour of the benzine motor. Then, too, the public has a preference for all electrical contrivances, and the unfounded fear of explosion by the benzine motor works also to its prejudice. These reasons are sufficient to assure preference for the electric automobile. The benzine automobile is used principally for transporting heavy loads, where great speed is desired in the case of long distances, heavy grades, and where other difficulties are likely to occur. Hence its adoption for brewery waggons, drays, omnibus lines connecting railway stations with inland towns, and for carrying persons and loads in the country.

Obituary.

CHARLES BARRY, F.R.I.B.A.—Mr. Charles Barry the eminent architect died at Worthing on Saturday last, 3rd inst. He was the eldest son of the late Sir Charles Barry, architect of the Houses of Parliament, and was born 21st September, 1823. He was educated at Sevenoaks Grammar School, and received his professional training under his father to whom he acted as assistant for several years. In 1846, owing to the failure of his health he went abroad, travelling through France, Germany, and Italy, and studying the architectural works in those countries. When he returned to England after a year and a half's absence he started practice on his own account, associating with himself as partner the late Mr. Robert R. Banks, who had been for some years one of the principal assistants of the elder Barry. In 1856, at the International Competition for the Government Public Offices, the design sent in by Messrs. Banks and Barry was placed second in merit by the Assessors for the then projected Foreign-office, although the buildings of the Foreign and other offices was carried out by Mr. (afterwards Sir Gilbert) Scott. The Royal Society's and other Societies buildings at Burlington-house with the front in Piccadilly were the work of Mr. Barry and his partner.

Since 1858 Mr. Barry held the office of architect and surveyor to the Dulwich estate, and there he erected several churches and a large number of private residences besides his work at the old College and the erection of the new College. In 1872 his partnership came to an end owing to the death of his friend and partner Mr. Banks. In 1876 Mr. Barry was elected President of the Royal Institute of British Architects, which office he held for three years. In 1878 he was one of the Royal Commission for the French Exhibition of that year, and in recognition of his services the French Government conferred on him the Cross of an officer of the Legion of Honour. In 1877 he received from the Royal Institute of British Architects the Queen's Gold Medal, which is awarded once in three years to an architect of eminence.

Mr. Barry was a member of the Society of Arts of long standing, having been elected as far back as 1869. In 1887 he was a member of the Council, and on February 10th, 1891, he presided at a meeting of the Applied Art Section, when Mr. Heywood Sumner read a paper on "Sgraffito."

SIR GEORGE GROVE, C.B.—Sir George Grove, the eminent musical critic and editor of the standard "Dictionary of Music and Musicians," died on Monday evening, 28th May, after a long continued illness. He was born on August 13th, 1820, and after passing through Clapham Grammar School he was articled to Mr. Alexander Gordon, civil engineer, and for two years he worked in Napier's factory at Broomielaw, near Glasgow. In 1841 and again in 1845 he was employed in the West Indies, in the former year in the erection of the Morant Point lighthouse, Jamaica, and in the latter of the Gibb's Hill lighthouse in Bermuda. Subsequently he was employed in the works on the Britannia Tubular Bridge. Mr. Grove was elected in 1850 Secretary to the Society of Arts in succession to Mr. Scott Russell, and in this office he was intimately associated with the arrangements for the Exhibition of 1851 which at this time occupied much of the attention of the Society under the auspices of whose President, H.R.H. The Prince Consort, the Exhibition came into being. This led to his appointment as Secretary of the newly formed Crystal Palace at Sydenham, and to his consequent resignation of his office of Secretary to the Society of Arts. It was in connection with the Crystal Palace that Mr. Grove commenced his endeavours to educate the public in musical matters. As the writer in an appreciative notice in *The Times* says, in respect to the European fame of the Crystal Palace concerts, which were started in 1885: "The series of analyses, signed with the familiar initial 'G.,' opened the eyes of ordinary people, who were really 'fond of music,' to the possibilities of a more intellectual form of pleasure, which music had it in its power to impart, and the fact that the programmes avoided almost entirely the use of terms which might be deemed obscure ensured for them a universal recognition."

In 1874, after his resignation of the Secretaryship of the Crystal Palace, a testimonial was presented to him by his former colleagues. His analyses of Beethoven's "Symphonies" were published in book form, with some additions, in 1896. On the foundation of the Royal College of Music in 1892, he was appointed the first Director, and held the office until 1894, when he was elected a Member of the Council. He was knighted in 1883 and was made a C.B. in 1894.

Sir George Grove was a man of wide interests, and his contributions to literature were very varied in character. He was editor of *Macmillan's Magazine* from 1868 to 1883, and during eleven years he was fully employed as editor of his "Dictionary of Music," which was commenced in 1878 and the appendix issued in 1889. He wrote many articles in Smith's "Dictionary of the Bible," and being deeply interested in Biblical geography he was largely instrumental in the promotion of the Palestine Exploration Fund. He was also a frequent correspondent of *The Times* on musical subjects.

William T. Radford, M.D. — Dr. Radford, who died at his house Sidmount, Sidmouth, on Saturday, 19th May, was a life member of the Society of Arts of long standing, having been elected in 1856. He was the elder son of Mr. Peter Radford, one of the house surgeons of the Devon and Exeter Hospital (d. 1815), and was born at Exeter in 1810. He was educated at Bristol, under Dr. Carpenter and Dr. Martineau. Although he took the degree of M.D., he did not practice, but devoted himself to study. He was specially interested in meteorology, and made monthly reports on the climate of Sidmouth. Some twenty or thirty years ago, being annoyed by the deception practised by itinerant vendors of spectacles and the injury caused to lace workers of the district, Dr. Radford commenced the peculiar form of charity by which he became known throughout the south-west of England—that of giving away spectacles. From that time to a few months ago, when he was compelled to cease his gifts, he gave away about 36,000 pairs. He was also a liberal supporter of local and other charities.

General Notes.

A National Repository for Science and Art.—Mr. Charles H. Read, F.S.A., Keeper of the Department of British and Mediæval Antiquities and Ethnography, British Museum, has written, as follows, to the *The Times* respecting Prof. Petrie's paper:—"I have read with some astonishment your report this morning of Professor Petrie's lecture at the Society of Arts on Wednesday [May 16]. Speaking of prehistoric man, Professor Petrie is reported to have said that 'There was scarcely a single burial preserved in any museum, though they might see long rows of objects from such tombs divorced from all else that belonged to them.' Has Professor Petrie never heard of Canon Greenwell, who during a long life has excavated a great number of British burials, depositing the relics in the British Museum, where the contents of each grave are carefully kept apart? Does not Professor Petrie know the splendid work of the same kind that occupied the late General Pitt-Rivers for the last twenty years of his life in Dorsetshire? His museum at Farnham in that county contains the result of these thoroughly scientific explorations, and the plans, models, and sections there shown, together with the published records, form a monument of care and method in archæological investigations that has probably never been equalled."

Great Seal of England.—In connection with Mr. Allan Wyon's paper on "The Great Seals of England" (see *ante* p. 42) it may be noted that in the House of Commons on Monday, 28th inst., the Right Hon. Robert Hanbury, Secretary to the Treasury, said:—"In 1897 it was represented to the Treasury that the present Seal had been in use for nearly 20 years and twice as long as the average time during which previous Great Seals had lasted. New Great Seals were made in 1838, 1860, and 1878. Since 1878 many documents which had formerly to pass the Great Seal have under statute been impressed with a wafer instead. It was also stated that the mechanical parts of the Great Seal were worn out, and that the fittings and ornaments had become sensibly defaced. The Seal itself, I am informed, requires careful cleaning, but there may be technical difficulties in the way of sending the Seal to be cleaned and refitted. The cost of the 1838 Seal is not known, that made in 1860 cost £413, and that of 1878 £513; the new one will cost £400."

MEETINGS FOR THE ENSUING WEEK.

Monday, June 11...Engineers, Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Algernon Hamo Binyon, "Notes on Electric Traction."
Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Messrs. W. J. Dibbin and G. Thudichum, "The Maintenance of Aëration as a Standard of Purity of Sewage Effluents." 2. Messrs. Frederick B. Power and Frank Sheddon, "The Composition and Determination of Cerium Oxalate." 3. Mr. F. G. Welch, "The Production of Nitrate of Soda in Chili."

Tuesday, June 12...East India Association, Westminster Town-hall, S.W., 3½ p.m. Mr. Archibald Colquhoun, "Afghanistan, the Key to India."
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m. Mr. H. L. Aldis, "The Construction of Photographic Objectives—Mathematical Investigation."
Anthropological, 3, Hanover-square, W., 8½ p.m.
Colonial, Whitehall-rooms, Whitehall-place, S.W., 8 p.m. Mr. L. Phillips, "Outlook in South Africa."
Asiatic, 22, Albemarle-street, W. 4 p.m.
Gas Institute, in the Theatre of the United Service Inst., Whitehall, S.W., 10½ a.m. Annual Meeting. Reading of Papers and Discussion.

Wednesday, June 13...Japan Society, 20, Hanover-square, W., 8½ p.m. Annual General Meeting.
Gas Institute, in the Theatre of the United Service Inst., Whitehall, S.W., 11 a.m. Papers and Discussion (continued).

Thursday, June 14...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Historical, St. Martin's Town-hall, Charing-cross-road, W.C., 8½ p.m.
Mathematical, 22, Albemarle-street, W., 8 p.m.

Friday, June 16... Quekett Microscopical 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, JUNE 15, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Forty-sixth Annual General Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 27th June, at 4 p.m.

(By order of the Council),
Henry Trueman Wood,
Secretary.

MEDALS.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1899-1900.

To D. E. Hutchins, Conservator of Forests, Cape Town, for his paper on "National Forestry."

To Sir W. Martin Conway, M.A., for his paper on "Some of the Undeveloped Resources of Bolivia."

To Edmund Wilson, for his paper on "The Housing of the Poor."

To Professor R. W. Wood, for his paper on "The Diffraction Process of Colour Photography."

To Edwin Bale, R.I., for his paper on "Artistic Copyright."

To Miss Halsey, for her paper on "Some Unfamiliar Masterpieces of the Italian School."

To Professor W. M. Flinders Petrie, D.C.L., for his paper on "A National Repository of Science and Art."

To A. R. Colquhoun, for his paper on "Russia, Persia, and Afghanistan."

To Sir William Lee-Warner, K.C.S.I., M.A., for his paper on "Our Work in India in the 19th Century."

To Christopher Rawson, F.I.C., for his paper on "The Cultivation, Manufacture, and Use of Indigo —Position of the Industry in India."

To John Ferguson, for his paper on "Old and New Colombo."

To the Right Hon. Sir Charles Wentworth Dilke, Bart., M.P., for his paper on "The Century in Our Colonies."

To Cyril Davenport, for his paper on "Niello Work."

To Lasenby Liberty, for his paper on "English Furniture."

CONVERSAZIONE.

The Society's *Conversazione* will take place at the Natural History Museum, Cromwell-road, S.W. (by permission of the Trustees of the British Museum), on Wednesday evening, the 20th June.

The reception by Sir John Wolfe Barry, K.C.B., F.R.S., Chairman, and the other Members of the Council, will commence at 9 p.m.

The following portions of the Museum will be open:—On the Ground Floor—the Central Hall, North Saloon, Fossil Mammalia and Reptilia Galleries; on the First Floor—the East and West Corridors.

A selection of music will be performed by the Band of the Coldstream Guards in the Central Hall, and by the Band of the Royal Engineers in the Fossil Mammalia Gallery, commencing at 9 o'clock.

Each member has received a card for himself (which is not transferable), and a card for a lady. In addition to this, a limited number of tickets are on sale to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the date of the *Conversazione*. On that day the price will be raised to 7s. 6d. These tickets can only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman.

Light refreshments (tea, coffee, ices, claret cup, &c.) will be supplied.

The entrance to the Museum is in the Cromwell-road. Carriages must enter the grounds by the East Gate, and leave by the West Gate.

The cards must be given up on entering the Museum.

Visitors arriving or leaving by either of the Metropolitan Railways will be allowed the use of the District Company's Subway, which leads from the South Kensington Railway Station direct into the grounds of the Museum.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

EXAMINATIONS, 1901.

In future the Society of Arts Examinations will consist of Three Grades.

I. Preliminary or Junior.
II. General or Intermediate.
III. Senior.

[It is not proposed to hold an examination in the Senior Grade in 1901.]

The standard for Grade II. will be, for the present, the same as that of the existing examinations of the Society, and the regulations will generally be the same as those previously in force, except that, in addition to the certificate granted in each subject, a Certificate of Proficiency in Commercial Knowledge will be issued to any candidate who has passed in the following five subjects within a period of three years :—

1. Arithmetic.
2. Book-keeping.
3. Précis-writing.
4. Shorthand.
5. A modern language.

The subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The usual programme, with full details, will be issued as soon as ready. In the meantime the information now published is subject to revision.

The examination for the *Preliminary or Junior Certificate* is adapted to the attainments of the genuine continuation school pupil who, after reaching Standards VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. There is, however, no limitation of age.

Certificates of two classes will be given in each of the subjects enumerated. In addition, a certificate of Proficiency in Elementary Commercial Knowledge will be given to any candidate passing in the following four subjects within a space of three years :—

1. Handwriting.
2. Shorthand.
3. Elementary Book-keeping and Office Routine.
4. Commercial Arithmetic.

Every pupil, before he is given his Certificate of Proficiency, will be required to produce such evidence of general education as that he has been in Standard VI., or has passed the lowest grade of the examination of the College of Preceptors or the Preliminary Local Examinations, or otherwise has reached such a standard of general education as may appear satisfactory to the Council.

Examinations will also be held in the following optional subjects :—

(*a*). Commercial History and Geography.
(*b*). Preliminary French.
(*c*). Preliminary German
(*d*). Elements of Typewriting.

The subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The Fees will be :—In Grade II., as now, 2s. 6d. for each subject, and 2s. 6d. for the Certificate of Proficiency. In Grade I., 2s. for each subject, and 2s. for the Certificate of Proficiency.

The next examinations will be held in March, 1901. The precise date will be hereafter announced.

SYLLABUSES (*Preliminary Grade*).

I.—Handwriting and Correspondence.

(1). Candidates are required to copy out a roughly written business letter into a good office hand, fold in an envelope, and direct it.

(2). A number of signatures and addresses will be given to candidates, who will be expected to make a fair copy in the form of a list of the names and addresses.

(3). A letter and reply will be furnished and the candidates will be expected to write out clearly, in a few lines, the points at issue.

(4). A letter with fairly full notes for reply will be furnished, and the candidates will be required to write the reply in full.

II.—Shorthand.

(1). Two business letters will be read out, one at a speed of 30 words a minute and the other at a speed

of 50. These will be taken down in shorthand by the candidates.

(2). One of these letters must be transcribed into longhand.

III.—Book-keeping and Office Routine.

(1). Candidates must be prepared to show that they know the meaning of simple business terms and abbreviations.

(2). Questions must be answered on the use of ordinary business Forms, Bank Notes, Cheques, Receipts, Order Books, Postage, Petty Cash Books, and Stock Books.

(3). Exercises will be set in the use of the Ledger and the posting of simple transactions.

(4). A general knowledge of the more important Postal and Telegraph regulations and of some one method of copying and filing Correspondence will be required.

IV.—Commercial Arithmetic.

(1). Candidates will be expected to work examples in Practice, Proportion, Interest and Stocks, the finding of areas and volumes.

(2). Problems will be set involving the use of short methods of multiplication and division and approximations.

(3). The student's knowledge of the more common uses of the Metric systems in commerce will be tested, together with the conversion of the more common Foreign Currencies and Measures and Weights.

(4). A speed and accuracy test of long additions nd cross additions will be set.

Optional Subjects.

A.—Commercial History and Geography.

(1). Candidates will be expected to have some nowledge of the principal industries of the United Kingdom, to enumerate their local centres, with the istorical and geographical reasons for such location, ogether with the life and discoveries of those inentors principally responsible for the present position f those industries.

(2). Some knowledge will be required of the leadng foreign and colonial sources of our raw material, ogether with any historical or geographical reasons or the production of each article in its locality.

(3). Similar questions will be set upon the chief arkets for our Exports, with the reasons for this ommercial intercourse.

(4). Some knowledge will be required of the leadg trade routes, railways and canals, with their dvantages as regards British trade.

(5). The making of maps and the giving of a escription of the student's own town, district, or ounty will be required.

B.—Preliminary French.

(1). Candidates will not be expected to have an tensive vocabulary of commercial or technical terms, d the rendering of the less usual words will be supplied to the candidates in both the composition exercises.

(2). A sound elementary knowledge of grammar, with special reference to the verb, will be required.

(3). Correspondence in both French and English will be given for translation.

(4). Idioms and simple phrases in French will be set for translation.

C.—Preliminary German.

(1). Candidates will not be expected to have an extensive vocabulary of commercial or technical terms, and the rendering of the less usual words will be supplied to the candidates in both the composition exercises.

(2). A sound elementary knowledge of grammar will be required.

(3). Correspondence in both German and English will be given for translation.

(4). Idioms and simple phrases in German will be set for translation.

D.—Elements of Typewriting.

Candidates will be expected to type carefully—

(1). A commercial letter from a draft written without punctuation or division into paragraphs.

(2). An estimate, invoice, or balance sheet in tabular form.

Accuracy will be considered more important than speed.

Proceedings of the Society.

FOREIGN & COLONIAL SECTION.

Monday, May 28, 1900; The Right Hon. Sir Henry H. Fowler, G.C.S.I., M.P., in the chair.

The paper read was—

IMPERIAL TELEGRAPHIC COMMUNICATION.

By Sir Edward A. Sassoon, Bart., M.P.

If regularity of intercourse, if rapidity and security in the exchange of views and wants, be the indispensable links in the chain of Imperial Federation and Imperial Unity, then I may hope that we are justified in contending that of all the means calculated to advance those ends as contributing elements, none approaches the aid of the electric spark as assisting in the riveting and cementing of these scattered fragments of a nation, destined by the imperious force of circumstances to be welded together as the grandest Imperial

hegemony that the world has ever yet seen. The moral connection of these outlying portions of the Empire with the Mother Country has been sealed by and consecrated with blood, the way has been paved for confirming the strong sentiment thus evoked by establishing still firmer the bonds of material and common interests, which, as in this work-a-day world, form the only stable foundations, on which to secure the permanence and solidity of this vast Imperial confederation.

After such short preface, let us cast a glance upon the origin of the cable system, which has done so much to assist the interests of which I have made mention. With modest beginnings, in tentative stages, with enterprises that, at the time of their initiation, were generally regarded as but vague and nebulous ambitions, promoted by enthusiasts and fanatics, the system of telegraphic communication to America, India, and the Colonies, has gradually developed into a vast and successful business, binding in its wide-spread ramifications the various portions of the Empire by an organism of sentient nerves, each throbbing with a new and a quickened pulse, each collaborating with the other, each performing its functions in such a way as to advance the aspirations, and so assisting to consolidate the interests, of this congeries of commonwealths into an indivisible whole. Now, we must assume that cable enterprises, in their inception, have been considered as undertakings in which the speculative interest predominates. We assume this, amongst other reasons, because successive Governments—as far back as 1858—have felt it more prudent, or perhaps more practicable, to entrust such work to private agencies aided by subventions. The Red Sea cable was one of the first submarine cables to be laid. A considerable guarantee was given to the company that undertook the work which, although the cables proved a failure, has entailed on the Government the duty of restoring the invested capital, and this, together with the interest due at $4\frac{1}{2}$ per cent., will when fully paid off in 1908, amount to the sum of £1,656,000. This beginning was not an encouraging one, but gradually, as the need of telegraphs became more appreciated and more pronounced, and synchronously with the opening of the Suez Canal, the man to whom the world owes so much for his clear prescience and his dauntless sagacity in telegraph matters—I mean the late Sir John Pender—founded the Eastern Telegraph Company, of which he was for so long the leading spirit. Were it within the scope of this paper I would willingly recall to your recollection the names of these pioneers who, associated with Sir John Pender and Lord William Hay (now known to us as the Marquess of Tweeddale) did so much to initiate and consolidate the work to which I shall in the course of this evening have to refer. Let me now give a short sketch of the origin of the company in question.

The Eastern Telegraph Company was formed in November, 1872, as the result of the amalgamation of four then existing companies which had come into being between May, 1868, and February, 1870. These were the Anglo-Mediterranean, the British India Submarine, the Falmouth, Gibraltar and Malta, and the Marseilles, Algiers, and Malta Telegraph Companies, having a total issued capital of about £2,560,000, and jointly owning some 8,500 miles of cable besides various land lines. Another step in a similar direction was the formation of the Eastern Extension, Australasia and China Telegraph Company. This was brought about under the same controlling mind by the fusion in 1873 of three companies which had originated between October, 1869, and January, 1870. These were the British India Extension, the China Submarine, and the British Australian Telegraphic Companies, which owned jointly about 5,200 miles of cable and had an effective capital of about £1,628,000 as well as some £33,600 in debentures.

The successive development of these companies drew the attention of capitalists to the possibilities of profit which might be expected from this class of enterprise. The outcome of this awakening was a marvellous extension and development of a network of cables spreading under the depths of seas and oceans. Landlines connecting the cables with one another were rapidly erected, until it seemed that no civilised portion of the earth's surface was likely to remain unaffected by the electric fluid. But it is not only in the spanning of immense distances, nor in the manifold character and extent of the world's intercourse carried on by this agency, that the last half of this century's telegraphic achievements are to be measured. Simultaneously with these gigantic strides we find all the signs of a technical progress and scientific development which arrest attention, as instanced by inventions for improved methods of telegraphy which are continually being made still more perfect. By the discovery and authoritative enunciation of the laws upon which are based the conditions

requisite for economy of time, labour, and material in the transmission of electrical impulses through long submarine cables, the improvement of these and of the instruments used in working them has been greatly facilitated.

In view of the costliness of submarine cable lines as compared with land wires, resort was had to Government assistance in the shape of subsidies and special facilities for landing rights. This aid was granted to English companies with no stinted hand, not only by our own Government, but also by the Governments of foreign States. It had to be recognised that the construction, laying, maintenance, and repairs, and working expenses, involved not only the sinking of a very large amount of privately subscribed capital, but the necessity of providing, out of traffic receipts, a fair interest on the capital sunk, as well as a considerable surplus wherewith to build up a reserve fund. This fund is necessary to provide against contingencies of repair, as well as for the subsequent renewal of the entire cable plant, when age and the consequent mechanical deterioration of the sheathing of cables precludes the possibility of their being raised for repairs; this need is not so great now as it was in the past, owing to improved methods of construction. It, however, does not appear to have occurred to the Department specially concerned in granting the landing concessions material assistance, and which also procured the assistance and protection of our Foreign Office, in respect of the relations of the cable companies with foreign powers, to foresee the demand that would inevitably arise for gradually cheapened tariffs. That international rivalry in all that appertains to commercial activity has become very keen is an indisputable proposition, and, as a natural consequence, it is only to be expected that in any subject having so great and so direct an influence on trade relations as in the case of telegraphy, the question of tariffs is subjected to keen public scrutiny and criticism.

A reduction of all necessary charges, incident to modern development of commercial methods, has become a vital necessity, and cable charges enter very largely into the laying down costs of commodities. Of course, where transactions of magnitude are concerned, this may be a negligible quantity. But the bulk of business with Oriental, and with undeveloped countries especially, partakes of a character where the commission receivable does not exceed £5 or £10, so that whether a message, say of five words, relating to such business costs £1, or 10s., becomes, as you may easily judge, a factor of considerable importance. We must bear in mind that it is the small capitalist who benefits to the greatest extent by the existence of telegraph communication, which allows of his turning over his capital rapidly, a process which was impossible to him in the days when he was dependent on slow and irregular means of communicating with his foreign correspondents. As regards the social, as apart from the commercial side of the question, the cost of a telegram to India or the Far East may be looked on as prohibitory in almost every case. Hence arises the grievance which the community feels that it suffers under the very unbridled control of the telegraph companies.

In all Railway Bills, certainly in those of modern times, there appears a clause giving the Board of Trade the right of objection to rates which may be oppressive in their incidence. In Gas and Electric Light Bills a similar power is reserved. But no such vigilant foresight appears to have been exercised in respect of the many concessions granted to cable companies in recent years. And what has been the consequence? With a phenomenal expansion of cable traffic, the financial resources have equally expanded, and these companies have found themselves, thanks to this position of assisted superiority, powerful enough to expropriate small competing companies. This process of absorption has enabled the Eastern Telegraph and its associate companies to become masters of the situation, and to snap their fingers at Governments as well as at communities, in reply to the reasonable demands made by them for lower rates. In fact, if not in law, they have become an oppressive monopoly with tariffs so abnormal, so arbitrary, and so capricious in relation to comparative distances traversed, that the telegraphing public has at last risen in revolt. It is doubtful whether, in any one instance, the reduction in rates which has from time to time so grudgingly been made has not actually been forced from the associated companies by the dread of impending competition, and in every case the reductions so compelled have, in a very short period, more than recouped the companies for the temporary loss which must naturally be expected to follow on the reduction until the public have realised the situation. No leverage actually exists to compel the companies to reduce, although their gross earnings have vastly increased within the last few years.

Mr. French, the Postmaster-General of Cape Colony, reported in 1898 (speaking of the cable recently laid from the Cape, *viâ* St. Helena and Ascension):—"I would wish to remark that, in my opinion, no subsidies should be given by the Cape in connection with the revised scheme, as the traffic receipts at the present time appear to warrant the laying of an additional cable on commercial grounds alone, without the aid of a subsidy from the Cape or Natal, or any State in South Africa. At all events, if the Eastern Company does not lay a third cable, it will be worth while for some other company to do so, and this would lead to competition in rates, which would undoubtedly be beneficial to South Africa."

Sir Gordon Sprigg also reported in the same sense, adding that, "As monopolists, the company must make some concession to meet legitimate public requirements."

The above are the opinions, strongly enough expressed it may be, of men who had every opportunity of getting a thorough insight into the relations between the companies on the one hand, and the Cape Government and the telegraphing public on the other. A short account of these relations may interest the audience as showing the methods of this powerful group of companies. The original cable to Durban was laid from Aden along the east coast of Africa, as a consequence of the Zulu War in 1879. Subsequently, in 1893, the company which effected this work, the Eastern and South African Telegraph Company, an off-shoot of the parent Eastern Company, also laid cables branching from the main line at Zanzibar, to the Seychelle Islands and Mauritius; they also took over the cables of the African Direct Telegraph Company, which run from the Cape to Mossamedes along the south-west coast of Africa. For the original portion of their line this company has drawn altogether up till the end of last year the sum of £1,200,000 in subsidies, while the subsidies received for the remainder of their system bring the total up to £1,368,000. This has enabled the company in question to defy competition, and thus to conduct their business in the way which seemed best in their eyes; and this way must also have seemed good to the shareholders, as during several years the dividends paid have been as high as 18 and 19½ per cent. But little is publicly known of the accounts of this company. The Eastern Company are also shareholders in other companies, viz., the African Direct and the West African Telegraph Companies, which connect with the Cape by cables along the West Coast of Africa, which companies receive in subsidies, partly from the British but mainly from Foreign Governments, subventions which up to the present time amount to something like £963,000. From these data one can form an opinion of the strong position in which these companies stand *vis-à-vis* any competitor, who, unaided by the exceptional advantages they have managed to secure, may wish to enter into competition on terms which could not fail to benefit the telegraphing public. Yet with all these advantages, or rather because of them, these companies have been content for years past to maintain their cables in a state of only mediocre efficiency, and for each much-grudged reduction made in the rates to South Africa have striven their utmost to extract the best possible terms from the Governments in the shape of extension of duration of subsidies, &c.

In consequence, mainly, I believe, of the agitation which has been recently maintained in regard to the telegraph grievances of the public, the associated companies are at last being brought to a proper consideration of their position in relation to the public. Some year or two ago, when the long-deferred Pacific cable scheme was at length recognised by her Majesty's Government, and by the Governments of the Australian colonies, the Eastern group found that the foundation of monopoly on what they had for so long securely stood, was no longer firm, and, therefore, bestirred themselves to do their best to prevent the establishment of a line which would inevitably compete with theirs. To effect this object the companies proposed as a preliminary step to lay a line of cables from the Cape to Sierra Leone, touching at St. Helena and Ascension on the way. This step was in any case requisite, not only because of the unsatisfactory condition of their then existing lines, but also because, as the Postmaster-General of Cape Colony points out that their traffic receipts warranted the laying of a third cable, possibly by a competing company. As this was the most imminent danger it was attacked before dealing directly with the Pacific scheme. But, as in former cases the companies demanded State assistance for executing a work which it was obviously in their own interest to carry out. To provide these cables between England, the Cape, and Australia, touching only at Gibraltar, Sierra Leone, Ascension, St. Helena, Mauritius, Rodriguez, and the Keeling Islands, with a branch from the Seychelle Islands t

Ceylon, touching at Diego Garcia on the way, the companies asked for annual subsidies amounting to £100,000 per annum beyond the large subventions which they already received from the Cape, Natal, and other South African Governments. Besides this a land line service, estimated to cost £12,000 a year, was to be provided by the Cape Government, and a subterranean line between Falmouth and London was to be presented by her Majesty's Government. This proposition, however, met with the rejection which it so richly deserved, both, as we have seen, from the Government in the Cape and also from her Majesty's Government. The danger of competition, however, still remained, and to meet it the companies have had to lay this year a cable from the Cape northward *viâ* St. Helena and Ascension, but instead of landing this on British territory at Sierra Leone, it terminates at the Portuguese island of St. Vincent, there meeting other allied cables, which reach England *viâ* Madeira and Lisbon. For this they receive no Government grant beyond the sum of £10,000 given them to expedite the work. The impending realisation of the Pacific cable scheme has shown these companies that the time for trifling has passed, and they now propose to lay the Cape to Australia cable, to which I have referred, abandoning all claim to the subventions, which they at first had asked for doing this work, and even going a step further in offering to reduce the rates which they have been charging to Australia. In the case of two of the colonies, with whom they have come to suitable terms—South and Western Australia—the rate has already been lowered, and at present a message from London to Australia costs 4s. per word, or exactly the same as is charged to Bombay (half the distance), although to reach its destination this message actually passes through Bombay! It has obviously been the interest of the grouped companies to do what they could to prevent the competition of the Pacific cable. This they have done, very skilfully so far. At each period of its somewhat long career, when the Pacific cable scheme seemed to approach achievement, the interest of the Colonies flagged, mainly because at each of these critical moments it was found convenient by the associated companies to lower their rates, with the effect of lulling the Australian public into a sense of satisfaction. Although not carried out for that purpose, this process affords us, and should surely afford to the companies in question, a lesson in the benefit to be derived from such diminution of charges to the telegraphing public. Let me give you a few figures.

In the year 1886 the rate was reduced from 10s. 8d. to 9s. 4d. per word from Australia to England, and the gross revenue of the Eastern Extension &c. Company, then stood at £441,799. In 1891, when the rate came down from 9s. 4d. to 4s. per word, the revenue stood at £508,536, but it was necessary in January, 1893, to slightly increase the figure from 4s. to 4s. 9d.; during that year the revenue was £509,684, and in 1899 at the 4s. 9d. rate the revenue stood at £663,811. This is an increase of nearly £250,000 over the year 1886, in which the first reduction was made. Surely these figures carry a moral with them. The advantage derived is not to be measured only by the extra £250,000 which the company now gains annually; we must also bear in mind that this reduction of about 50 per cent. with such results means not only a large saving to the ordinary telegraphing public connected with Australia, but also that telegraphy has come more and more into the reach of those to whom it was impossible at the former high rates. The Australian public have thus benefited directly to the extent of many hundreds of thousands of pounds, while as regards the company they are in all £1,250,000 better off than they would have been had their revenue remained only at the figure at which it stood in 1886, when they began to reduce their rates. The above gross revenue also includes traffic with China and the Far East, to which places also the rates have been reduced.

Thus we find that the Pacific cable scheme has really been a blessing in disguise to those who dreaded it most, and who were most opposed to it, and also to those of the colonies who have proved but lukewarm and shortsighted supporters. Recently an attempt, to some extent a successful one, has been made in Australia to cripple the Pacific project by granting to the companies the right to establish offices in the principal towns for the collection of traffic, thus giving them the power to canvass for custom, to offer rebates, and to send all telegrams handed in, by their own lines, unless the sender expressly writes on the telegram that these should be sent by the Pacific. Such a permission seems to me to be quite beyond the power of any of the colonies to grant, who are co-partners in the Pacific cable with Great Britain and Canada, without consulting these latter. I understand that recent negotiations show a probability of difficulties being overcome by the company agreeing to sell their interest

in the proposed Cape-Australia cable at some future time should the Imperial Government wish to take it over, but on the subject of State purchase I may ask your attention later on, and I have reason to know that in that event the objection that Canada has been raising to the grant of these rights will be waived.

For some reason the associated companies do not regard with favour the all-British route. It is, therefore, not surprising that they should use every endeavour to quash a scheme which is the key to the all-British cable position. That the ultimate possession of submarine cables by the State is only a question of time is my firm belief. I should be prepared to argue for it, and to point out its unrivalled advantages to the Empire, when the time is ripe for such a discussion. For the present we must be content to so shape our course with regard to any pending or future agreements with cable companies, as to enable the State to acquire the cables whenever such a course should be dictated by the requirements of the public service on lines somewhat similar to those for which precedent affords us a guide, as for example in the taking over of the Submarine Company across the Channel by her Majesty's Government.

As long ago as 1892, the authors of "Imperial Defence" emphasised their conviction as to the imperative necessity that we should be connected by a series of purely British cables, with no shore ends on foreign territory, for purposes of the strategic defence of the Empire, and more especially in order to assure in time of war communication between its various portions. Curiously enough, the wisdom of this contention was demonstrated in a singular manner, when an incident arose recently in connection with the Venezuelan dispute. At the climax of the controversy, our North American squadron was in the neighbourhood of Trinidad, but it was promptly ordered away from these waters, the scene of the probable trouble, by the Home Government. It is now explained that the squadron returned to Bermuda, at that time the terminus of the British Direct Cable Companies' line, to enable her Majesty's Government to telegraph instructions without these having to pass through the country directly concerned, which would have been the case had the fleet remained at Trinidad.

The French Government have lately awakened to the strategic importance of a system of cables touching only on French territory, and a Bill was recently passed by the Chamber to assist, by substantial Government grants, the laying of such cables under Government control. I understand that the obstacles presented by the exclusive concessions possessed by the cable companies in Egypt are to be circumvented by means of a land line passing through Turkish territory, by way of El Arish down to Akabah on the Red Sea. The United States also wished to lay the cable from California to the Hawaiian Islands as a State work, this being the first link of their proposed cable line across the Pacific to the Philippines and China.

But to return to the all-British cables, it seems necessary that further stipulations than those enabling the State to assume ownership should be inserted in all future agreements, namely, a definite scale of charges, based on probable or ascertained gross earnings, and moving on a sliding scale. No extension of any line, whether now existing or prospectively to be laid, should be permitted (except, of course, any temporary line to meet exceptional emergencies), that would conflict with, or diverge from, the all-British system. No absorption or amalgamation of any new concern by an existing one should be able to be brought about except with the full cognizance and concurrence of the Home Government; and, lastly, no exclusive privileges or terms be granted, precluding the possibility of competition by other agencies.

We now come to the most striking illustration of the disadvantages due to the neglect of such stipulations and of the total absence of them. This instance is found in the agreements which have been entered into by the Indian Government with the existing cable companies. The consequence is that, although the charges to India, notably, and to the Far East, have been universally admitted to be of an exorbitant nature, and constitute a severe tax upon commerce and industrial enterprises, as well as upon the community socially, the companies themselves not attempting to defend those rates, still the anomaly remains as a monument of callous indifference to public interest. Government seems to be powerless, commercial communities here and in India have been loudly protesting against the situation, but in vain, until hope deferred has almost produced the proverbial effect.

It is apparent that there is something radically wrong in a state of affairs when we find the Indian Government apparently

inert and enmeshed in agreements in consequence of which it can make no move to advance the interests of the Indian public by the reduction of rates. Not only is this the case, but it would appear that these agreements are such, that the Government is financially a loser by the connection which it has formed with these companies, and that in one instance such loss has been incurred to assist in the reduction of Australian rates—a reduction undertaken as a purely self-defensive measure against competition by one of the Eastern groups of companies. The example we refer to is what is known to the initiated as the "Australian Message Fund," which on analysis seems to be a joint-purse fund, established in 1891, for the benefit of the Eastern Extension Telegraph Company by the Eastern Telegraph Company, the Indo-European Telegraph Company, and the Indo-European Telegraph Department of the Indian Government. This "benevolent fund" has also at its beginning been assisted to some extent by the Australian colonies. The origin of this seems to have been due to the laudable attempt made by the Eastern Extension Company to ward off the impending competition of a Pacific cable, by a reduction of rates equal to about 50 per cent. This was undoubtedly of advantage to those telegraphing to and from Australia, and has since proved to have been a very profitable step on the part of the Company; but, I ask, of what benefit has this been to India? Why should India, to whom these companies have consistently refused any reduction of charge, be led to subscribe to such a fund at a financial loss to herself?

Let us glance briefly at the facts of this case as gathered from the latest available information, which beginning in 1891 ends in 1898. Owing to the anticipated drop in revenue due to the reduction of Australian tariff, the Eastern Extension Company received from these Colonies a total of £56,331. But this allowance terminated in the year 1894-95, as by that time the revenue of the company had returned to its former level. So much for the share of the Colonies; but concurrently with these payments, and continuously since, we find that the amounts paid in to this fund by the Eastern Company, the Indo-European Telegraph Company and the Indian Telegraphs go on increasing regularly, whereas, on the other hand, the amount drawn out by the beneficiary company (which, of course, consists of the balances left in the pool by the joint-purse partners) goes on steadily increasing. The following figures will serve to make this relation clearer.

In all, since the establishment of this message fund, until the year 1899, the Eastern Extension Company has received from its partners, irrespective of the Australian Colonies, a sum amounting to £688,000, of which India has paid £46,877. From an examination of the figures it appears that India has bound herself to pay into the pool just double the amount which she draws out; whereas the Eastern Extension Company draws out just double what she pays in.

Now, we cannot but ask ourselves why India should have entered into such an alliance, the effect of which I venture to say is to sacrifice to some extent the opportunities of a reduced Anglo-Indian rate? The other members of the joint fund, who own the lines which run between England and India, have frequently protested their inability to lower their charges to India, yet in this case we find them subscribing largely from their earnings, gained to a great extent from Indian traffic, to assist another member of their group to lower the rates to Australia to the same level at which the Indian rate has so long been left stationary. I venture to assert confidently that the Indian Government, instead of abetting this course of action, should have done everything possible against it, and that the Cis-Indian companies would have been more just and more far-seeing had they invested the money which they are now handing to Australia in the more obvious duty of reducing Indian rates.

Some negotiations are assumed to be in progress between the companies and the India Council, but the terms of these have not transpired. As a shareholder in the Eastern Telegraph Company, and as the spokesman of the Imperial Telegraphic Committee in the House of Commons, I venture to submit that no reduction of less than 75 per cent., on the Indian tariff at all events, can be regarded as satisfactory. On the other hand, it would perhaps be unfair to throw the burden of the whole probable temporary deficit upon the Eastern Company, and in my humble judgment the Indian Government, as primarily concerned, and the Treasury should conjointly agree to guarantee one-third of any loss on the present revenue, with the proviso that, when the deficit to both parties is eventually recouped through the expansion of traffic which, according to all experience must come about quickly, then the companies should agree to a further reduction of 3d. per word, bringing

the rate down to 9d. From the evidence given by the officials of the Eastern Company before the Pacific Cable Committee, it is demonstrated that for all trans-Indian messages with an Australasian destination the share of the Eastern Company for transmitting the message as far as India from England, and *vice versa*, is only 1s. $2\frac{1}{2}$d. per word; and yet they apparently are contented, and seem to thrive on this amount, which is less than a third of the charge which Indian commerce at present pays for equal service.

I have drawn your attention to the sympathetic attitude of the Indian Government towards the companies with whom they have allied themselves in a way which does not seem to give the best results to the telegraphing public, who, presumably, are an influential factor in the prosperity of India. It seems that the International Telegraph Convention can be used at will, either as a shield to fend off criticism, or as a cradle to foster the interests of the monopolists. This is not as it should be; and is in no way consistent, either with the interests of the "working bees" of the Empire, or with the credit of a great Government Department. We know that a telegram can be sent from London to the frontier of Afghanistan by the Russian land lines for $5\frac{1}{2}$d. per word. We also know that if the Amir, forgetting the handsome subsidy he receives from India, objects to a line crossing to Peshawur, it may be constructed through Beluchistan to meet existing land lines. We have thus, if we include the 2d. per word charged throughout India for ordinary telegrams, a total of $7\frac{1}{2}$d. per word from London to Calcutta, were it not for the gap between the Indian frontier and the Russian office at Sarakhs; and yet we are charged 4s. per word! The gap referred to is not surely one which it is beyond the administrative capacity of Indian officialdom to deal with; and I understand that at present such a line as I refer to is in course of construction. There is no reason to take objection to a Russian land line service; indeed, one of the partners in the joint-purse scheme, the Indo-European Telegraph Company, has only recently increased by $7\frac{1}{2}$ per cent. the amount of tribute which it pays to Russia.

Should it be objected that in avoiding Afghanistan and passing through Beluchistan, Persia must be dealt with, then, if, negotiation is of no avail, we know that a telegram to the furthest east of Persia only costs 1s. 6d. per word, and the line across Beluchistan cannot call for any such tariff as will bring a telegram up to even 2s. per word. The Convention may be advanced again as an excuse, but it is not a convincing one; and as it may be denounced at will, it should no longer be allowed to interfere with the reasonable amendments which are so much required.

I would here like to explain a misconception in the public mind as to the degree of importance we attach to the cultivation of the land lines as factors in the situation. I look upon them really as feeders and auxiliaries to the cables, as calculated to relieve congestion of traffic to be expected on the introduction of cheapened rates. But our reliance must be on our cable system, which, in course of time, will have to be added to with the augmentation of public needs and the consequent expansion of traffic.

There is an extraordinary secrecy maintained in connection with the joint-purse arrangement between the Indian Government and the companies. What the *raison d'être* of that agreement may be is shrouded in impenetrable darkness. What we do see, however, is, that while the Indian Telegraph Department has its coffers full to overflowing, and hands a large portion of its surplus profits over to the companies, the commercial communities have been persistently denied all relief. One does not expect a Government Department to embarrass itself with dividends, but we find that the Indo-European Department of the Indian Government Telegraphs has been paying dividends for the last five years of 6, $6\frac{1}{2}$, and $7\frac{1}{2}$ per cent.; and this in spite of the sums paid into the joint-purse, apparently more for the benefit of the co-partner companies than for the advantage of the telegraphing public.

There is another curious anomaly which deserves attention. This is to be found in the relation existing between the Treasury in England and the companies in connection with the payment of terminal and transi taxes. According to the "Réglements" o the International Telegraph Convention, o which her Majesty's Government are sig natories, a certain sum, 2d. a word terminal, $1\frac{1}{2}$d. a word transit, should be paid to th Government by the companies on each word o the extra-European *régime* reaching, or passin through, Great Britain by telegraph. But thi sum is not paid, owing to a clause in th Telegraph Act of 1869, the time when th land telegraphs were taken over by the Govern ment. It is, you will agree with me, perfectl arguable that the ratification of the St. Peters burg Convention and the amending "regula

tions" having been subsequent to the Telegraph Act, and also that, where the Governments concerned do not avail themselves of such tax, the fact is expressly mentioned. For instance, in the case of the Egyptian Government, the action of the Treasury in benevolently rejecting a sum which cannot be less than £50,000 is open to a very grave question. If the Government, which purports to receive these taxes, does not require this sum for departmental purposes, then surely the benefit should be given to the telegraphic public rather than that it should be handed over to these private companies. The present position is all the more strange, as it appears that one of the telegraph companies, the Anglo-American Company, which is affected also by the Telegraph Act referred to, is bound by a memorandum exchanged with the English Government authorities, and which provides for revision of its agreement with the Government at stated periods and the expiry of the agreement in thirty years.

It has often been pointed out to us that the terms of the International Telegraph Convention prevent any reduction of rates on the part of the Indian Government, and attempts made in this direction at the last Conference (held at Buda-Pesth) by the Indian Government representative, were strongly and successfully opposed by the Associated Companies, but the laxity with which it is treated, as shown by the above instance, somewhat shakes our confidence in the infallibility of the Convention.

Again, would it be believed that the voting power of Great Britain at the Quinquennial International Conference, upon the fiat of which depend the value of our lines of communication, and the welfare of our commerce, in regard to a most important factor, is no more than that of Luxemburg or Roumania; and when we consider that Great Britain owns 113,000 miles, exclusive of her dependencies, out of the 175,000 miles of cable which exist, while neither of the States above mentioned owns any cables at all, the absurdity of the position becomes abundantly apparent. You will, therefore, see how imperative and urgent is the demand for a Royal Commission, when the next Parliament comes into being, to inquire into and investigate all these and other obscure points.

Here I would digress for one moment, to allude to the recent renewal of the Telegraph Convention between England and France for the long period of ten years, at the present rate of 2d. per word, or double the combined inland rate of the two countries. The French Minister of Telegraphs promised me his personal adhesion to the principle of some reduction. This branch of our Department, I understand, is in a flourishing condition, and yet no advances have been made by our Post Office for a lower rate. But let that pass. What strikes me in this new document is that the Post Office have agreed to debar this country from the employment of any fresh discovery except with the consent of the other contracting party. It is not beyond the range of probability that should a valuable discovery be made by a British subject, or a foreign subject under British auspices—and the name of that talented and brilliant inventor of wireless telegraphy, Signor Marconi, will occur to you all—we should meet with some obstruction on the part of the French Post Office, and we should then be precluded from availing ourselves of the benefits of such invention. I should have thought that a most rational way of providing for a contingency of this description would have been to have stipulated that, on proper patent rights being obtained, and the merits of the invention thus indisputably proved, the Post Offices of both countries should be compelled to adopt it for the use of the communities interested. We expect great things from our new Postmaster-General. Lord Londonderry's keen desire for work in the service of his country will find ample material and scope for satisfaction when he addresses his mind to the consideration of the long-delayed measures of reform, and to bringing them within the approximate range of practical economy. I hope that, unlike his predecessors, he will not take refuge in the theory of non-productivity—a theory relied upon by all heads of departments to clog and dog the footsteps of every project of reform, and a theory which has invariably been exploded by practice and experience.

We have had to run the gauntlet of adverse criticism; it has been proved to the satisfaction of our critics that, in conducting this agitation, we have been animated by some unrighteous desire to encroach upon their inalienable rights. The answer is, "We could not if we would." Obviously, in questions affecting the public weal, and where private enterprise is conducted primarily in the interests of the shareholders, a moment arises when such private rights have to suffer some diminution of their prestige and their influence. And

cable companies, who have had a fairly long and prosperous innings, and who have been shielded from financial loss and from competition by large Government subsidies, must expect to be confronted with public claims for a revision of the situation. It would be unreasonable that they should expect the public permanently to accept the burden in respect of a service of magnitude without exercising criticism, and calling for reform. They would do well to bow to the necessities of the situation, and to accept, with a good grace, such necessary reforms as the advance of invention and the increasing and strenuous commercial rivalry of foreign nations shows us cannot be any longer delayed, without depriving our Empire of the unfettered and ample use of this beneficent agency to which she has every legitimate claim.

DISCUSSION.

The CHAIRMAN said they were much indebted to Sir Edward Sassoon for his very interesting, lucid, and able paper. He had called attention to a very important subject—important at all times, and especially now—and had invited an inquiry into it which, if carried out on broad and proper lines, would be of great benefit to all classes of the community. He had been struck in listening to the paper by the re-echo of the history of this country in regard to all enterprises and inventions in their inception. The Government never began any enterprise. Such things were left for private individuals and private capital, and this plan had its advantages, especially where there were great riches, but with our past experience we could not defend that mode of procedure in relation to future enterprises. The telegraphs were for a long time in the hands of private companies, which were not much assisted by the Government. There was, perhaps, too much conservatism among Englishmen, as contrasted with Americans, in these matters. We were too much inclined to look with disfavour on new enterprises calculated to disturb existing conditions under which we had been progressing satisfactorily to ourselves. This submarine cable question was a very difficult one, and required to be treated with the greatest consideration, so as to be fair both to private individuals and to the public, who, he believed, had arrived at the conclusion that the cables ought not to be left in private hands. The question had several aspects—the commercial one in the first instance, and if it were confined to that it might be left to commercial men to settle, for they were able to take care of themselves, and see that they were not charged too much for a vital element in carrying on their business. But with Great Britain it was fa more than a commercial enterprise. It had a social and personal character, as they were all realising just now. What was it they were all looking forward to now with the greatest interest? It was the knitting together of the subjects of the Queen in various parts of the dominions of the Queen into one united Empire, feeling an impulse from the centre, but at the same time carrying on their own local government according to their own necessities. We wanted to bring our colonial fellow-subjects into closer connection with us day by day, and that could not be done unless facilities of communication were increased at the lowest possible expense, and in a great empire like ours that was worth paying money for, not regarding it simply as a business to be carried on at a profit. The telegraphic system of this country was not carried on at a profit; there was not 1s. interest paid on the ten millions of capital which that enterprise represented, and a large annual loss was defrayed out of the revenue in order to give the public the daily convenience of cheap telegraphic communication. He doubted very much the possibility of any Government daring to propose any increase in the cost of the home telegraph system. The people would say to any such proposal, No, it was a national service, a national advantage, and was worth while paying for. The argument applied with equal force to the colonies, and also to India. Probably every man in the room was proud of our great Indian Empire, and was prepared to make all the sacrifices necessary for the proper carrying out by this great country of the great trust committed to her in respect to India. It was of supreme importance on every ground that our intercourse with India, whether of passengers, goods, or telegraphic communication, should be as full and unrestricted as possible. But there was another point of view which had been too much lost sight of during the last 25 years, and that was the military aspect. A great Empire like ours with colonies in every part of the globe ought to have a communication of its own under the control of its own Government, independent of all private companies, independent of all foreign nations, and this would be a very powerful element in its military equipment, whatever might happen. The paper had shown that there were a great many questions connected with this matter which required further investigation. He agreed with Sir Edward Sassoon that the time had arrived when there should be an independent inquiry of impartial, competent men to go into the past history of the case, the present condition of the companies, and the wisest course to be adopted. If so conducted, the inquiry would be careful in regard to the fair and legitimate interests concerned, and at the same time would point out to Parliament, the Government, and the nation at large, if there was any, and, if any, what change to be effected in so important and potent an instrument between the home Government, the Indian Empire, and the Colonial Empire, in which at present he thought there were many weak spots and possible dangers against which we ought to guard. As he

d to return to the House of Commons, he would k Sir Owen Burne to take his place, but he could t leave without again expressing his obligation to r Edward Sassoon for the light he had thrown on is important question.

Major-General Sir Owen Tudor Burne, G.C.I.E., .C.S.I., here took the chair.

Sir PATRICK PLAYFAIR, C.I.E., said all who were gaged in commerce in India would agree that the legraphic charges were a severe tax on trade, on the dustries of the country, and on the social com-unity; and there was great dissatisfaction felt in dia at the way in which she had been treated in mparison with the Australasian colonies. He be-ved the present position of affairs was owing to the luctance on the part of the Government of India to bsidise the telegraph companies or guarantee traffic, hich was to some extent the result of opinions ex-essed some years ago by Government officials in dia, that it would be unfair to assess the general xpayer with any part of the deficiency which might mporarily accrue by the lowering of the tariff by or 75 per cent. It was held by them that the nefit would operate on a small and mainly ropean section of the community in contradis-ction to the Natives. In recent days, however, ere had been a spontaneous demand from the tive community for fuller telegraphic communication th Europe. The natives were much interested in e war news from South Africa, and they knew how e Indian princes had come forward most loyally to fer their support. His Highness the Maharaja of arbhangah, in the Viceroy's Council, said he con-lered the agitation for a reduction in telegraph tes was a much better way of meeting the com-aints of the Press with regard to the Press Messages ll than by any amendment of its clauses, and Lord rzon after reconsideration had withdrawn that Bill, d had shown much interest in bringing about a duction in the telegraph rates. That this support substantial was shown in the last financial state-ent by Mr. James Finlay, Secretary to the overnment of India, where he mentions specially increase in the receipts of the Telegraphic epartment to the amount of 13½ lacs of rupees, consequence of the interest the people of India ok in the war news, and also on account of the use ade of the telegraph in connection with the move-ent of grain owing to the famine. Anything that und the natives of India more closely to Great itain was highly to be desired, and it seemed to him at a reduction in telegraph rates must promote this. course, the position of the telegraph company must recognised, and he saw no other way out of the ficulty than that suggested in the paper, namely, it they should be subsidised, or guaranteed traffic a limited period. If he recollected rightly £8,000 r annum was charged in the Indian accounts as noiety of the subsidy payable for the unfortunate Red Sea cable, which would expire in 1908, and that sum would thereupon be available if required for a reduction of rates. They all believed that this would only be required temporarily and that the lower tariff would so increase the traffic as to make it remunerative. He was quite certain from long com-mercial experience that a lowering of rates would lead to the abolition of that abomination, the code, to the convenience of merchants and the telegraph com-panies, and that the journals would be able to give much better information.

The Hon. GEORGE PEEL, after compliment-ing Sir Edward Sassoon on his paper, said the broad issue facing them was whether this enterprise was to be in the hands of private persons or of the State. At the present moment there were open, or shortly would be, 190,000 miles of submarine cable, of which only 20,000 were in the hands of the State, and these were mainly in territorial or inland waters. Almost the whole of the great in-ternational traffic, therefore, was conducted by private enterprise, and the reasons for that were manifold. In the first place, Governments did not care to embark their capital and credit in so risky an enterprise, and next they felt that public func-tionaries were not the proper persons to create in-ternational trade. It had been said that to have the cables in the hands of the State, would confer unrivalled advantages, but how were they to be acquired? There were only three ways of proceeding. First, that the State should purchase them, about which there were many difficulties. There were three lines to South Africa; if the whole were bought up, the expense would be enormous; if the two inferior ones only were bought, it would be very foolish; and if the superior line only were bought, it would be unjust. Then, supposing they were bought, if the rates were maintained where would be the advantage? If they were lowered, it would be to the benefit not only of our own merchants, but of the French, German, and Portu-guese colonies, and thus we should be incurring a loss, or, at any rate, pledging the credit of the State for the benefit of foreign nations. It might be suggested that differential rates should be charged in favour of our own colonies, but the only result would be that foreign nations would run cables of their own; and then a loss might be incurred on working our own cables, and, at the same time, there would be competition with this country where there was none before. A second method suggested was the insertion of a clause in every contract giving landing rights, reserving to the State the option of purchasing the cable; but that would be futile. It would only apply to future cables, and there would be complications when one end of the cable was landed on foreign shores. The third suggestion was that the State should make its own cables; and the best comment on that proposal was, to point to what had happened with regard to the

proposed line from Australia to Canada. From the year 1879, when Sir John Macdonald and others approached Lord Beaconsfield on the subject, the project had been talked of, but no private company had yet laid the cables, nor had the State done so either. What was the scheme which had been discussed for 21 years? He found that the estimate was, that on the first year of working, though they could raise the money at $2\frac{1}{2}$ per cent., there would be a loss of £54,000 a year; but in his opinion that prospect was far too rosy, for it seemed to him that the loss would be considerably greater. It was not correct to say that the Government granted a monopoly to the companies, the nearest to it was in the case of Egypt, where there was a preferential right, and the State could buy up the cable if it wished. There was a subsidy in the case of Africa, but the whole route between Australia and England was open without subsidy. It was given in Africa in order to give communication which otherwise could not be provided. One word with regard to India. It was evident that it was better to have two lines than one, a submarine line and a land line, and that there should be a working arrangement between them otherwise one line might kill the other. In 1877 the submarine line was going to kill the land line because of the war with Russia, and, therefore, a working arrangement was made. It was equally possible if there were war with France that the submarine line might be cut, and therefore it was desirable to have a land line as well. With regard to the rate, he had heard with astonishment the suggestion that it should be 1s. a word, for unless there were a great increase the loss would be £270,000 a year, or if the traffic were to increase an additional cable would have to be provided, the capital for which, at a 1s. tariff, would not be remunerative. It had been said that the rates were very unequal and were far too high, but rates could not be made strictly proportional to the length of the route, it depended a great deal on the volume of the traffic. In 1903 the rate to Canada would be 1s., and to India and Australia probably 2s. 6d. or 2s. He desired to state in conclusion that these were his own personal views and were not expressed on behalf of the telegraph companies; his interest in the subject arose from the fact that he was a director of the Eastern Extension Telegraph Company.

Sir JOHN LENG, M.P., said he thought Mr. Peel would be a very able exponent of the views of the telegraph companies before the intended Committee or the Royal Commission, but there was scarcely time for discussing those questions. He had listened with great pleasure to Sir Patrick Playfair, who was an excellent representative of the views of the commercial classes of India; and as he knew, from meeting him there some years ago, he took a deep interest in this question. Representing a commercial community in this country which had an extensive connection with India, he entirely shared his views. They were much indebted to Sir Edward Sassoon for putting forward with so much ability the views o men of business. They were already enjoying th first fruits of his efforts, for it was very doubtful i they would have got the reductions in the charges t India unless he had moved in the matter. That wa only the beginning of the movement, and it wa highly encouraging. As Sir Henry Fowler had said, i was not merely a matter of local interest, or of particular colony, it was a matter of world-wid interest; and there could be no truer Imperialisn than that which sought to connect, by direct, speedy and cheap communication, every part of the Empir with every other part. There was scarcely any on but had some social interest in some distant part c the Empire; and when any emergency arose, the were astonished to find that even a brief communi cation could not take place with Australia or Ne Zealand without an enormous expense. The grea work which Sir Edward Sassoon was doing was i breaking down the apathy of the Government on th question; there was far too much tendency to tur a blind eye or a deaf ear to anything calculated t promote the interests of commerce. Representin Dundee, he might say that the Chamber of Con merce there, and in fact the Chambers of Commerc throughout the country, were much indebted to S Edward Sassoon.

Sir M. M. BHOWNAGGREE, K.C.I.E., M.P., said h also wished to associate himself with previous speake in thanking Sir Edward Sassoon for bringing publ opinion to bear on this great question, and he was gla to think that it had been taken up by a gentleman wh was the bearer of a traditional name in Anglo-India commerce. So far, the results of his efforts had bee to reduce very appreciably the rate between Englar and India, which had suffered greatly by the hig charges hitherto maintained. There was a gene sentiment now aroused throughout India, both the native and European communities, on this que tion. Mr. Peel seemed to think India had no rig to claim a reduction, and referred to the volu of traffic, but he did not at all agree with him. T fact was that India was much too weak to ass itself in these matters. The Australian and oth colonial communities were vigorous and energet and asserted their rights, but poor India was mu He rejoiced to hear it said by Mr. Hanbury recen that India had suffered from this tyranny much t long. He did not complain of one Government mo than another, because each party had been equa remiss, but he hoped a better day was coming. Bo from a social and commercial point of view, it w important that the control of the telegraphs shou be British, and that the rates should be as cheap possible.

Mr. CHARLES BRIGHT, wished to heart congratulate Sir Edward Sassoon on the co plete and able manner in which he had dealt w the subject. He thought, however, it was

asonable to expect the companies to reduce tes to 1s., when they had already assured em that there would be the loss by a reiction of rates from 4s. to 2s. 6d. Any one who id followed up the history of submarine telegraphy om its infancy would know that, by their own owing, the companies should be losing heavily on e existing line to Australia, owing to having entually conceded a certain reduction of tariff which ey had previously asserted would mean a loss of any thousand pounds a year. Assuming that these eavy losses were a fact—notwithstanding large diviends and big reserve funds—surely they could not ok to these companies, to cripple themselves any rther in other directions—such as India—but must ok about elsewhere to see if others were prepared run the risk. He could not think the risk very eavy, if anything like an enterprising spirit were own, such as that by railway companies in opening new suburbs. He did not think it had been fficiently realised how often a supply created a emand in matters telegraphic as much as in anything se. Let them turn for a moment to the land line stem of this country now in the hands of the State, id compare the number of messages daily nveyed with what it was when the State took er the lines from the companies in 1869, and id to extend the telegraph to all manner of outing and non-paying stations; and at the same time mpare the rates then with those of the present day. o one thought of sending a telegraph message in ose days on the small domestic topics that were nt nowadays at the 6d. rate. Just as telegraphic mmunication opened up a country and developed ade, so also low rates inspired the idea of using the legraph where such a thing was never thought of fore. How many people would ever think of using e submarine cable for domestic messages in the me way that they do the inland wire—except on tal occasions? Yet this might all be altered by oper reductions. It might be argued that the fact the rates being high was the cause of the traffic ing small, just as well as the cause and effect being it the other way. As Sir Edward Sassoon pointed it, the submarine telegraph concerned the small isiness man more than any one; and to him it was consideration whether he paid £1 or 10s. for a essage. Surely, also, there was something illogical out the suggestion of the Secretary to the reasury, in the recent House of Commons Cable ebate, that because the carrying capacity of a cable as only about a tenth of that of a land line that, erefore, the rates should be proportionately higher. s a matter of fact, the carrying capacity of a cable ould be increased to almost anything, provided the affic were sufficient to warrant the initial cost of nstruction suitable for high speed automatic transission. Mr. Hanbury further talked of the present ble to India being unable to carry more traffic if the tes were reduced; but this only tended to show at so great would be the increase of traffic that we should require more alternative lines—which was true for a variety of reasons. In point of fact, he thought the rates had been much more governed of late by considerations of competition, or the chances of it, than by traffic considerations. We have as an example the present rate of 1s. a word across the Atlantic, where originally it was a minimum of £20 for twenty words. Witness the fact, moreover, that with Government competition (in the shape of the projected All-British Pacific Cable) staring them in the face, the companies had already very much modified their contentions and tactics. We have an instance of this in the Cape to Australia cable which is now to be laid without any subsidy whatever, and at reduced rates where previously one of £34,000 a year had been asked for a number of years and without any reduction of rates. Moreover, as a further result of outside criticism, this line is now to go direct to Adelaide instead of relying on an unsatisfactory land line to Perth in order to communicate with the important side of Australia. This cable would be most useful, if only as a duplication of the existing "Eastern" line to Australasia, but it could not be considered in any sense as a substitute for the "All British" Pacific Cable. For one reason it would not touch Canada. But it would take material time for them to do this sufficiently for practical purposes, and, meanwhile, the public were kept waiting. Turning to the strategic aspect of the matter, in the House of Commons debate, Mr. Hanbury mentioned that any cable touching on foreign territory could, if necessary, be cut at a moment's notice; but surely that pointed as much as anything to the desirability of a number of alternative cables on various routes and in deep water. With reference to Mr. Hanbury's objection to a public inquiry, there was nothing in regard to the landing places and working arrangements of existing submarine cables and their companies that foreign countries did not know already or could not easily learn from existing publications, companies' meetings, &c. He was not, at first sight, entirely in favour of the State taking over the cable system, or of anything in the shape of checking private enterprise; but when it was remembered that the land telegraphs of this country were absorbed by the Government, though the companies who had previously worked them as a private speculation were not similarly responsible for the taxpayer's money, it seemed that the public had certainly more of a *locus standi* in the present case, so far as dictating terms, &c., was concerned. It must not be forgotten that, notwithstanding these supposed heavy losses on traffic by reduced rates, these companies (who had shown great foresight in their business investment) had done uncommonly well for themselves on account of the policy pursued. They would, he thought, have been better advised in the long run if they had been more prepared to lay alternative lines and reduce rates. They would not then have had all the Chambers of Commerce and other important bodies

against them. The term "pioneers" had been sometimes applied to the business rulers of these companies, but obviously that was a misapplication, for the pioneers—as in all engineering undertakings—were of course those who had first constructed, laid, and worked the lines. Whilst talking of subsidies, Mr. Hanbury drew a distinction between subsidies from the mother country and the colonies; but surely in the case of cables from this country to the colonies it should scarcely affect the argument in an Imperial Parliament what part of the Empire the subsidies came from as regards the Briton's right of say in the matter. He should like to know, in conclusion, what would be thought if there was any serious delay in the Imperial mail service, yet continual telegraphic breakdowns were still of more urgent consequence.

Mr. C. E. Pitman, C.I.E. (late Director-General of Indian Telegraphs), said the gentleman who held a brief for the cable companies had impressed on them very strongly the difficulty and expense of laying an extra cable to India, which he said would cost £1,800,000, but he had read lately that one of these poor companies had spontaneously come forward with a contribution of something over a million to provide another cable to Australia, which did not look like pauperism. It was said they could not carry more traffic, but if a railway company with a single line found it could not carry the traffic coming to it it immediately doubled the line, and if necessary trebled it, and the same rule should apply to a cable. He must say he thought India had been treated very badly. For years and years they had had the cry "Perish India," and India had been persistently sat upon by the War-office, the Admiralty, the India Office, the P. and O. Company, and the cable companies. America was 3,000 miles off and there was a 1s. rate. India was 6,000 miles away and why should not she have a 2s. rate as a maximum? Australia was about double that distance and she had a 4s. rate, and he did not see why India should be charged the same as Australia when all messages went *viâ* India. The high rate strangled the traffic and prevented any personal or domestic messages being sent. There were only a few hundreds in the year, whereas at reasonable rates there would be very many, because Englishmen did not settle in India as they did in Canada, Australia, and the Cape, but were always in communion with the mother country, and had the intention of returning home. There was constant correspondence but it was all by letter except in very rare instances on account of the prohibitive charges for telegrams. He was not inimical to the cable companies in any way; they had risked their money, and had had a very good return; but he advocated a large reduction of tariff between India and Europe, not England only, because there were many French and German and other foreign firms in India. When there was a conference in 1896, the cable companies had a pistol held at their heads loaded with blank cartridge only, because at the time there was a gre difference of opinion in India amongst the vario Chambers of Commerce, and the demand for a re duction was put forward in a half-hearted way; bu now they were all unanimous, and, within the la year, had put forward identical demands, whic were strongly backed by the Viceroy, Lord Curzon and the Government of India. The pistol was no loaded with balled ammunition. He did not wan to quarrel with the cable companies, but there was limit to human patience, and if they would not mak fair terms, the Government would be quite justifie in entering into competition with them. What for it should take he was not prepared to say, but h saw no reason why a cable company should not b guaranteed a minimum rate of interest as well as railway company.

Mr. Robert Kaye Gray said he sympathise very much with Sir Edward Sassoon, but would on say a few words as to the cause of the present positi and the Pacific cable. That cable should have bee laid by the Eastern Cable Company and the Easter Extension Company, for their own protection, an to give a thoroughly Imperial route. One reas they did not undertake it was on account of th out-payments which would have to be made other administrations, which they did not like, an therefore said the cost would be enormous, an raised all sorts of difficulties. The late S John Pender, according to the report of a mee ing at Ottawa, had said, "The cable is n wanted; the cable cannot be laid; but if it to be laid, we are the people to do it." He d not do it, but played the Governments and the pub like the good fisherman he was, and threw eve obstacle in the way for the sake of gaining time. T Eastern and Eastern Extension Companies were no going to lay a cable from the Cape to Austral which would cost about the same as the Paci cable. They intended to go from Durban Mauritius, Rodriguez Island, the Cocos Islands, an on to Australia; and the stations on the Pacific li would be equally likely to be profitable. Fiji mig be put very much in the same category as Mauriti Fanning and Norfolk Islands being represented Rodriguez and Cocos in the Cape-Australia lin Even if the Pacific cable were laid, there was room f both lines.

The Chairman then formally moved a vote thanks to Sir Edward Sassoon, which was carri unanimously.

Sir Edward Sassoon, Bart., M.P., in reply, sai —I think the Society is to be complimented up having secured Sir H. H. Fowler as chairman. His p sence has given a tone to our discussions whi would have been imparted by no other statesma His great grasp of matters affecting services of pub

utility, his Imperialist views, irrespective of party considerations, have earned for him a position in the eyes of this country, enviable and unique. I now turn to the observations of my friend, Mr. George Peel. I think there is a good deal in what he advanced, but they are obviously matters of controversy, and in spite of his ability I scarcely believe that he and I can settle the highly debatable points between ourselves. I could not have desired a better advocate for a thorough inquiry than himself. His whole speech tended to the undoubted expediency of a thorough investigation. In view of the shortness of time I shall not attempt to reply to the speech now, but I shall take the opportunity of the Empire Congress to go fully into the points raised by him.

Mr. C. E. TWISADAY writes:—There is one point which seems to have been overlooked by all the speakers, but it is one which has a very important bearing on the reduction of rates and the position of the cable companies in this matter. I refer to the International Telegraph Convention, which is practically a book of international laws originally drawn up at St. Petersburg in 1876, and since revised at periodical conferences in which representatives of nearly all the European and Extra-European States take part. These laws are intended for the guidance and protection of all the Administrations and relate to the efficient working of the lines, the regulation of traffic, tariffs, &c. Among other things it is laid down that "Alterations of the rates or of the bases of application of the tariffs which may be agreed upon between interested States . . . . must have for object and effect not the creation of competitive charges between existing routes, but, on the contrary, the opening of as many routes as possible to the public at equal charges." This regulation is a protective one, inasmuch as it prevents the poorer Administrations from being ruined by their more powerful rivals, and it also prevents monopoly. It is also laid down that the consent of the administrations interested must be previously obtained to any proposed modification of tariff. At the present time there are three main routes to India, one *viâ* the Eastern Telegraph Company, one *viâ* the Indo-European Telegraph Company, whose lines pass through Germany, Russia, Persia, and the Persian Gulf, and the third *viâ* Turkey. This latter route was the original route to India, and up to the time that the Eastern and Indo-European Companies were opened in 1870, almost all the traffic to India passed over it. It may, therefore, be considered as the normal route, and the normal route is defined in the Convention "as the route for which the charge is the lowest." The Turkish route passes through various countries to Constantinople, and thence across Turkey in Asia to Fao and the Persian Gulf; but, unfortunately, the Constantinople-Fao section is in such a bad state of repair, and is so indifferently worked by the Turkish Administration that the route is practically useless. Repeated efforts have been made to induce the Turks to make their line efficient, or to lease it to the Indian Government, but, so far, without success, and what might be an important factor in fixing the through rate to India is, therefore, valueless. The through rate on the land routes to India is made up of the transit and terminal rates of the States through which the lines pass. These rates are settled at the different conferences and entered in the Conventions. They can only be modified at the conferences, or in the interval between the conferences, by the States interested. In the case of a message from India to Europe *viâ* Turkey, the Indian terminal rate is $57\frac{1}{2}$ centimes, the Persian Gulf transit rate is 1·905 francs, the Turkish transit rate is 1·195 francs, and these shares are retained by the respective Administrations. From the Turkish frontier there is a fixed mean route for Europe of $82\frac{1}{2}$ centimes, out of which the proportions due to the different transit and terminal Administrations are paid, and the profit or loss is retained or paid by the Administration which works the account. In the case of a message going *viâ* Russia the same system is adopted, but as the line between Teheran and England is worked by the Indo-European Telegraph Company, an arrangement is made by that company with the Persian, Russian, German, and British Administrations, by which the Conventional rates laid down for those countries are retained by the company and a royalty or fixed amount is paid to those Administrations by way of rent for the line. It will thus be seen that it is the European States who are mainly responsible for the tariff to India, and that it is impossible for any reductions to be made without their consent and co-operation and, as these special lines have to be maintained in a high state of efficiency, the expense of maintenance is very heavy and comparatively high tariffs are necessary. It must, moreover, be remembered that these lines are used exclusively for through messages, and no revenue can, therefore, be derived from local traffic. The case of the Eastern Telegraph Company is different. Their line consists solely of cables from England to Bombay, and they are not bound by any Government transit rates. They are, however, bound by the rules of the International Convention, and cannot, therefore, accept messages at lower rates than those in force on the land routes. Under these circumstances it is difficult to see where the so-called monopoly comes in, as it is open to the States interested, especially in the case of the Turkish route, to lay down their own rates at any International Conference or by common consent in the intervals between any conference, and the companies would be bound by these rates. I should like to say one word on the subject of codes, which were mentioned by one speaker. It is a curious fact that for the past 20 years or more the traffic with India has been practically stationary; and it is a still more significant fact that when the tariff was reduced from 4s. 6d. to

4s., in 1886, the revenue for the next six or seven years showed a falling off. This is no doubt due to the marvellous development of codes, and it has been estimated that one code word contains on an average 26 ordinary words. Code messages require specially expert and careful signallers, and such traffic is much more troublesome to deal with than ordinary messages. Almost all the traffic with India is Government or mercantile; and I suppose that at least 95 per cent. of it is in code, so that the actual cost to the senders is only about 2d. per ordinary word for a transit of over 3,000 miles of cable and land line, and I do not think any one can say that this is unreasonably high. The matter practically rests with the merchants themselves; and if they were to give up codes, and so allow the traffic to increase, there would be no difficulty in considerably lowering the rates, and thus introduce a fresh source of revenue, viz., social messages. Sir Edward Sassoon also referred to the Australian Message Fund Agreement, which he does not seem to think is favourable to the Government of India. In this he is mistaken, as the actual figures show that before the agreement was entered into in 1891, the revenue earned by the Indo-European Telegraph Department on this traffic was only £6,235, whereas in the year 1898-99, it had increased to £16,814.

Mr. Joseph Rippon writes:—There are one or two points to which I should like to draw attention concerning the strategic and commercial aspect of cables in the West Indies, as they have been referred to by Sir Edward Sassoon. It is, I believe, quite true that the North American Squadron fell back on Bermuda when the Venezuelan incident arose, and the only telegraphic route then was *viâ* the United States. Under these conditions the best naval and military authorities in the colonies were of the opinion that, if war had been declared, they might have found ships entering in various directions, and would not have been advised or able to tell if they were hostile or not. The colonies were at the mercy of circumstances. It was not until 1898 that the Direct Company's cable was laid from Bermuda, *viâ* Turks Island, to Jamaica, only two months before the commencement of the war between Spain and the United States. All other telegraph routes were then either closed or subject to censorship, and the Direct Cable was used practically as the only free route. In consequence, the North American Squadron remained at their usual winter station, in daily communication with the West India Islands, and ready to leave for any point where required. Business transactions were carried on as usual. Before the cable was laid it was determined that telegraphic charges should be reduced, say to Jamaica, from 5s. 10d. to 3s., *i.e.*, by nearly 50 per cent. to all the British West India Islands. The point I desire to make is that strategic lines are generally justified by results, that the net result of the ownership of all cables over all British territory would show a profit, and, if it did not, it would pay the Empire for any outlay. Communication was maintained to Cuba and all parts of the West Indies during the war. It is impossible to conceive that any strategic cable would not be more or less useful to commerce, and there still remain colonies in the West Indies which should be connected without any further delay.

Miscellaneous.

INDIAN AND CEYLON TEA.

Messrs. Gow, Wilson, and Stanton, in publishing a diagram showing the quantity of tea exported from India and Ceylon in each of the past ten years, and also the quantity consumed in the United Kingdom and taken by other countries, draw attention to the increase in the output of tea from India and Ceylon during the last year, which has been so heavy that they point out the necessity of making strenuous efforts for the further development of new outlets, in order to effectually cope with the anticipated surplus of this year's crop.

The diagram illustrates the expansion in production and consumption of British-grown tea. In 1898 277,000,000 lbs. were produced; 216,000,000 lbs. were taken for home consumption, and 62,000,000 lbs. were taken by countries outside Great Britain. In 1899 the amounts were respectively 305,000,000 lbs., 219,000,000 lbs., and 63,000,000 lbs. Through the development of new outlets demand fairly kept pace with supply until 1899, when the output exceeded consumption by fully 17,000,000 lbs., a condition which does not augur well for prospects in the immediate future.

In 1899 the production of Indian and Ceylon tea exceeded that of 1898 by 28,000,000 lbs., the total produced being 305,000,000 lbs. The world's consumption of Indian and Ceylon tea last year increased only 9,000,000 lbs., the total consumed being 288,000,000 lbs. Large areas of land in India were placed under tea cultivation a few years ago when Exchange was very low. This land is now commencing to bear leaf, and has been the chief cause of the increase in the 1899 crop from India. This is likely to continue during the next few years. The 1899 crop from Ceylon was the heaviest on record, and during the first four months of this year the increase had already amounted to 11,000,000 lbs. This excessive increase is probably due in great measure to the extensive use of manure. For years past, oversupply has been promptly dealt with by a fractional drop in price, such a decline invariably stimulating consumption. Now, however, increased supply cannot be dealt with in this manner, because, were the price to fall even as much as the duty has been increased the *retail price* would then be only what it was before the duty was raised. The foreign outlet which for many years has received the greatest

.ttention from India and Ceylon, as well as by far he most pecuniary assistance, is North America, ınd as a result, the black tea market in this continent ıas been practically captured; but out of a total :onsumption of 111,000,000 lbs., about 75,000,000 bs. consist of green and uncoloured tea.

It is unlikely that the green tea drinkers of North America will be converted into black tea drinkers; so hat it is necessary to supply them with the green ınd unfermented tea which they want and are ready o buy. Even if no better price could be obtained or such tea than for black, it appears advisable to ultivate this trade, because for every pound made he production of black tea is reduced by an equal quantity. This would minimise the danger of over upply of such teas as are sold in the United Kingdom, and consequently increase competition. The Ceylon fund has been allowing planters over 1½d. per b. as a bonus to produce this class of tea, and both Mr. Mackenzie, the Ceylon Commissioner, and Mr. Mr. Blechynden, the late Indian Commissioner, ıppointed to exploit North America, believe that the great outlet in the United States will be for tea of his description. This bonus will go far to obviate ny loss which might be entailed in selling, while the ' Thirty Committee" will doubtless continue to foster ts manufacture if prospects continued favourable for ts ultimate success. At the same time it must not e forgotton that if once a commencement were made n this direction, great possibilities exist for a profitable rade in other markets, such as South America, where green tea is largely used as well as Maté or Paraguay ea, besides North Africa, Persia and the neighbouring parts of Asia. The fact that British grown tea is o largely displacing black China tea in almost every narket hitherto attacked, is sufficient argument to varrant the belief that the green tea monopolies of China and Japan can be assailed with equal success, nd that by this means an enormous outlet may be pened for the surplus produce of India and Ceylon. t is important to remember that a very large proporion of China tea which was formerly used in the Australian colonies has now been displaced, so that it s doubtful whether the same rapid increase can take lace in these colonies as has been the case in the ast. The only large field for the displacement of lack China tea appears now to be Russia, which is gradually increasing its taste for the produce of India nd Ceylon, while the world's markets for green and ıncoloured tea still remain to be exploited.

Obituary.

Dr. C. A. Buchheim.—By the death of Charles Adolphus Buchheim, Ph.D., at his house at Harlesden, on Thursday, 7th inst., the Society of Arts loses he valuable services of its Examiner in German, who held that office since 1869. Dr. Buchheim was born in Moravia in 1828, and after studying at the University of Vienna and other Universities in Austria, came to this country in 1852. He was occupied as a teacher of the German language for some years, and in 1863 he was appointed Professor of the German Language and of German Literature at King's College, London, an office he held until the time of his death. For fifteen years he was Examiner in German for the University of London, and he also performed the same services for the Universities of Oxford, Cambridge, and New Zealand. He was for a time German tutor to the children of the Prince and Princess of Wales. He obtained the degree of Ph.D. from the University of Rostock, and in 1897 the University of Oxford presented him with the honorary degree of M.A. In January last, he received from the German Emperor the Order of the Red Eagle (third class). He was author and editor of a large number of books. Early in life he translated some of Dickens's works into German, and his annotated editions of German Classics, issued by the Clarendon Press, were highly esteemed. At the time of his death he was engaged upon a political history of Germany. A correspondent of the *Times* writes:—"He had always worked heartily in the interests of friendly Anglo-German relations. He wrote a number of essays in German magazines on England and the English, and, on the other hand, frequently discussed German life, thought, and art, in English periodicals. Thus, he sought not merely to teach German, and extend the knowledge of German literature, but to explain, by means of such teaching, the true spirit and the noblest aspirations of the German people."

General Notes.

Royal Institution.—At the general monthly meeting of the members of the Royal Institution, held on the 11th instant, the Managers reported that the following resolution on the retirement of Sir Frederick Bramwell from the office of Secretary had been passed:—"The Managers of the Royal Institution of Great Britain, on the occasion of the retirement of Sir Frederick Bramwell from the office of Honorary Secretary, desire to place on permanent record an expression of their high appreciation of the admirable way in which he has performed the duties of that office and of his signal services to the Institution generally. Elected a Member of the Royal Institution in 1876, Sir Frederick Bramwell has since then delivered seven Friday Evening Discourses on subjects cognate to that branch of applied science with the progress of which in this country, during the Victorian era, his name must ever remain honourably associated

Having joined the Board of Managers in 1879, he was induced in 1885, notwithstanding professional engagements of the most onerous and responsible character, to undertake the additional burden of the duties of Honorary Secretary to the Institution. For fifteen years these duties have absorbed no inconsiderable proportion of his time, and have been discharged with incomparable energy, business ability and courtesy. Himself a generous patron of the Institution, and foremost to support every project for its advantage, he has been able to suggest improvements in the administration of its property which have added to its material resources. Mainly concerned in the arrangement of the courses of Lectures and Friday Evening Discourses, he has succeeded with no small expenditure of labour in maintaining these at a high level of educational value, and in making them attractive and popular, and representative of every modern advancement in the arts and sciences. While extending the usefulness of the Institution in every direction, and introducing into it many new members, he has by his genial personality done much to promote smoothness and harmony of working in its several departments. The Managers feel that the Royal Institution has been singularly fortunate in having so long enjoyed the services of Sir Frederick Bramwell in the capacity of Honorary Secretary, and they rejoice to know that although he is no longer to fill that office, they are still to have the benefit of his counsels at their Board. Sir Frederick Bramwell's name is indelibly stamped upon the history of the Royal Institution for the last quarter of the 19th century. He will always be gratefully remembered by its members, but the Managers wish to add to personal remembrance this formal record of their cordial recognition of his merits."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 18...Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. K. A. Bullen, "Eolithic Flint Implements."

TUESDAY, JUNE 19...Waterworks' Engineers, Cardiff, 10 a.m. Annual Meeting. 1. Inaugural Address by the President, Mr. C. H. Priestley. 2. Mr. F. J. Bancroft, "The Rating of Water Undertakings." 3. Mr. Alfred J. Jenkins, "The Relationship between the Cost of Water wasted and the Cost of Detection." 4. Dr. Archibald E. Elliott, "The Strength of Bricks and Brickwork, with Demonstrations on the 100-ton Testing Machine."

Statistical (at the HOUSE OF THE SOCIETY OF ARTS), 5 p.m. Sir Charles Dilke, "The Defence Expenditure of the Empire."

Photographic, 66, Russell-square, W.C., 8 p.m.

Zoological, 3, Hanover-square, W., 8½ p.m. 1. Dr. Walter Kidd, "The Significance of the Hair-slope in certain Mammals." 2. Mr. F. E. Beddard, "The Anatomy of *Bassaricyon alleni*." 3. Mr. Nelson Annandale, "Observations on the Habits and Surroundings of Insects and other Animals made during the 'Skeat' Expedition to the Siamese Malay States."

WEDNESDAY, JUNE 20...SOCIETY OF ARTS, Conversazione at the Natural History Museum, South Kensington, 9 p.m.

Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Mr. William Marriott, "Rainfall in the West and East of England in relation to Altitude above Sea Level." 2. Mr. Joseph Baxendell, "Description of Halliwell's Self-Recording Rain Gauge."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 7½ p.m. A Demonstration on the Structure of some Palæozoic Plants, with Sections of the Plants thrown on the Screen, by Mr. W. Carruthers.

United Service Institution, Whitehall-yard, S.W., 3½ p.m. Mr. J. R. Thursfield, "The Training of Seamen."

Waterworks' Engineers, Cardiff, 10 a.m. Annual Meeting (continued).

Royal Society, Burlington-house, Piccadilly, W., 9 p.m. Soiree.

Institution of Mining and Metallurgy, Geological Museum, Jermyn-street, S.W., 8 p.m. 1. Mr. T. Davey, "The Extraction of Gold from Auriferous Pyrites by Amalgamation." 2. Mr. W. S. Welton, "Notes on Gold-Bearing Gravels." 3. Mr. A. James, "The Treatment of Kalgoorlie Sulpho-Telluride Ores."

THURSDAY, JUNE 21...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 3 p.m. 1. Dr. A. G. Ohlin, "Some Scandinavian Crustacea." 2. Mr. Chas. Chilton, "The Subterranean Amphipoda of the British Islands." 3. Miss Sweet, "Certain Glands of Australian Earthworms." 4. Dr. A. B. Rendle, "Notes on Nájas."

Chemical, Burlington-house, W., 8½ p.m. 1. Dr. L. Marchlewski and Mr. C. A. Schunck, "Notes on the Chemistry of Chlorophyll." 2. Dr. S. B. Schryver and Mr. F. H. Lees, "Researches on Morphine" (I.). 3. Messrs. W. H. Perkin, J. F. Thorpe, and C. W. Walker, "A New Series of Pentamethylene Derivatives" (I.). 4. Mr. W. H. Perkin and Dr. J. F. Thorpe, "Experiments on the Synthesis of Camphoric Acid" (III.). "The Action of Sodium and Methyl Iodide on Ethyldimethylbutanetricarboxylate" 5. Miss M. A. Whitely, "The Oxime of Mesoxamide and some Allied Compounds." 6. Messrs. W. Carter and W. T. Lawrence, "The Oxyphenoxy - and phenyleneoxy-acetic acids." 7. Dr. W. T. Lawrence, "The condensation of ethyl α bromo-isobutyrate with ethyl malonates and ethyl cyanacetates: α-methyl-α'-isobutylglutaric acid." 8. Dr. W. T. Lawrence, "Methylisoamylsuccinic acid." (II.)

Waterworks' Engineers, Cardiff, 10 p.m. Annual meeting continued.

Numismatic, 22, Albemarle-street, W., 7 p.m. Annual Meeting.

FRIDAY, JUNE 22...Waterworks' Engineers, Cardiff, 10 a.m. Annual Meeting (concluded).

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m. 1. Dr. P. Chappuis, "Notes on Gas Thermometry." 2. Mr. H. M. Tory, "A Comparison of Impure Platinum Thermometers." 3. Prof. J. Young, "On the Law of Cailletet and Mathias and the Critical Density."

SATURDAY, JUNE 23...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Journal of the Society of Arts,

No. 2,483. Vol. XLVIII.

FRIDAY, JUNE 22, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 40 of the Society's By-laws:—

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1900.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Messrs. Coutts and Co., 31st May, 1899	1,706	9	2			
Do. in hands of Secretary...	26	5	1			
				1,732	14	3
,, Subscriptions	5,053	13	0			
,, Life compositions	525	0	0			
				5,578	13	0
,, Dividends and Interest................................				579	16	0
,, Ground Rents				671	1	6
,, Examination Fees				1,484	0	0
,, Clothworkers' Company (Donation to Examination Prize Fund)				28	0	0
,, Conversazione, 1899 (sale of tickets)				51	15	0
,, Advertisements				373	15	9
,, Sales, &c.:—						
"Cantor" Lectures	24	14	0			
Examination Programmes......	24	7	10			
Fees for use of meeting-rooms	48	16	6			
Journal	136	12	11			
Reports of Technical Education Congress..................	1	6	7			
Reports on Acetylene Exhibition..................................	2	1	10			
Old Electric Lighting Plant...	80	0	0			
				317	19	8
				£10,817	15	2

Cr.

	£	s.	d.	£	s.	d.
By House:—						
Rent, Rates, and Taxes	799	17	0			
Insurance, Gas, Coal, House expenses and charges incidental to meetings	324	6	8			
Repairs and Alterations.........	72	3	5			
				1,196	7	1
,, Office:—						
Salaries and wages	2,022	16	7			
Stationery, Office Printing and Lithography	270	14	8			
Advertising	63	10	6			
Postage Stamps, Messengers' Fares, and Parcels	208	4	1			
				2,565	5	10
,, Library, Bookbinding, &c.............................				86	10	11
,, Conversazione (1899)......................................				398	5	0
,, *Journal*, including Printing and Publishing..				1,866	18	9
,, Advertisements (Agents and Printing)				264	15	2
,, Examinations				1,483	0	7
,, Medals:—						
Albert (sundry charges)	1	15	8			
Society's	18	18	0			
				20	13	8
,, Memorial Tablets				6	9	0
,, Repairs to Dr. Swiney's Tomb				11	2	6
,, "Owen Jones" Prizes......................................				21	0	0
,, Drawing Society's Prizes.............................				9	0	0
,, "Cantor" Lectures				175	15	0
,, Juvenile Lectures				30	0	0
,, Sections:—						
Applied Art...........................	50	16	0			
Foreign and Colonial	43	19	8			
Indian	67	1	2			
				161	16	10
,, International Congress on Technical Education..				6	6	0
,, Committees (General Expenses)				11	14	5
,, Electric Light Installation...........................				140	6	3
,, Grant to Widow of A. R. Cowdroy				250	0	0
,, Investment of Life Compositions for the year in Consols and War Loan, 1900				525	0	0
				9,230	7	0
,, Cash in hands of Messrs. Coutts and Co., May 31st, 1900				1,587	8	2
				£10,817	15	2

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	373 10 1	
,, Examiners' Fees	616 12 0	
,, Examination Prizes and Medals	137 5 0	
,, Sections:—Applied Art, Foreign and Colonial, and Indian	150 0 0	
,, Accumulation under Trusts	426 19 6	
		1,704 6 7
,, Excess of assets over liabilities		21,435 3 1
		£23,139 9 8

Assets.

	Amount of Stock, &c. £ s. d.	Worth on 31st May, 1900. £ s. d.	£ s. d.
By Society's Accumulated Funds invested as follows:			
Consols	1,976 5 7	2,000 19 8	
Canada 4 per Cent. Stock	500 0 0	515 0 0	
South Australia 4 per Cent. Stock	500 0 0	545 0 0	
N.S. Wales 3½ per Cent. Stock	530 10 1	551 15 6	
N.S. Wales 4 per Cent. Stock	500 0 0	585 0 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	281 0 0	
Queensland 4 per Cent. Bonds	1,500 0 0	1,575 0 0	
Natal 4 per Cent. Stock	500 0 0	560 0 0	
Ground Rents (amount invested)	10,496 2 9	10,496 2 9	
New River Co. Share (New)	100 0 0	417 10 0	
National War Loan	500 0 0	498 15 0	18,026 2 11
	17,319 18 5		
,, Subscriptions of the year uncollected		525 0 0	
,, Arrears, estimated as recoverable		110 0 0	
			635 0 0
,, Property of the Society (Books, Pictures, &c.)			2,000 0 0
,, Advertisements on the Books, due, and in course of execution			490 18 7
,, Cash in hands of Messrs. Coutts and Co., 31st May, 1900			1,587
,, Do. on Deposit (against interest on Trusts)			400 0
			£23,139 9

Funds held in Trust by the Society.

	£ s. d.	
Dr. Swiney's Bequest	£4,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100 0 0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133 6 8	,, ,, ,, of Interest as a Money Prize.
North London Exhibition Trust	192 2 1	,, ,, ,, ,,
"Fothergill" Trust	388 1 4	,, ,, ,, of a Medal.
J. Murray, in aid of a Building Fund	54 18 0	,,
Subscriptions to an Endowment Fund	562 2 2	,,
Dr. Aldred's Bequest	173 10 0	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	500 0 0	Metropolitan Railway 4 per Cent. Perpetual Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	2,450 0 0	Bombay and Baroda Railway Stock } Interest applied to the
	2,695 11 3	Ground-rents } Cantor Lectures.
"Owen Jones" Memorial Trust	423 0 0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On Deposit with Messrs. Coutts and Co.
	£14,608 17 6	

Total of Investments &c., Standing in the Name of the Society (including Society's accumulated Funds and Trusts as above).

		£ s. d.
Ground Rents (amount of cash invested)		£17,669 4 0
Consols		3,580 5 10
Metropolitan Railway 4 per Cent. Perpetual Preference Stock		500 0 0
Bombay and Baroda Railway 5 per Cent. Guaranteed Stock		2,450 0 0
Canada 4 per Cent. Stock		923 0 0
South Australia 4 per Cent. Stock		605 16 0
New South Wales 3½ per Cent. Stock		530 10 1
New South Wales 4 per Cent. Stock		500 0 0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock		2,170 0 0
Queensland 4 per Cent. Bonds		1,500 0 0
Natal 4 per Cent. Stock		500 0 0
New River Company Share (New)		100 0 0
National War Loan		500 0 0
Cash on Deposit with Messrs. Coutts and Co.		400 0 0
Society's Accumulated Funds	17,319 18 5	£31,928 15 11
Trust Funds held by Society	14,608 17 6	

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

Alverstone, Francis Cobb, } *Treasurers.*

Henry Trueman Wood, *Secretary.*
Society's House, Adelphi, 19th June, 1900.

Knox, Cropper, & Co., *Auditors.*

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Forty-sixth Annual General Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 27th June, at 4 p.m.

(By order of the Council),
HENRY TRUEMAN WOOD,
Secretary.

THE ALBERT MEDAL.

The Albert Medal for the year has, with the approval of His Royal Highness the Prince of Wales, President of the Society, been awarded to Mr. Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of magnetic and electric forces from quantities indefinitely small." This principle is the one on which the invention of the modern dynamo machine is based, and is employed in all modern dynamos.

CONVERSAZIONE.

The Society's Annual *Conversazione* was held at the Natural History Museum, Cromwell-road, S.W., on Wednesday evening last, 20th inst.

The reception was held in the Central Hall of the Museum by Sir John Wolfe Barry, K.C.B., F.R.S., Chairman, and the following members of the Council:—Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Lord Belhaven and Stenton, Mr. Francis Cobb, Dr. Ludwig Mond, F.R.S., Sir Westby B. Perceval, K.C.M.G., Sir Owen Roberts, D.C.L., Mr. Joseph Wilson Swan, F.R.S., Mr. William Luson Thomas, and Professor J. M. Thomson, LL.D., F.R.S.

The following portions of the Museum were open: On the Ground Floor—the Central Hall, North Saloon, Fossil Mammalia and Reptilia Galleries; on the First Floor—the East and West Corridors.

Promenade Concerts were given by the Band of the Coldstream Guards in the Central Hall, and by the Band of the Royal Engineers in the Fossil Mammalia Gallery.

The number of visitors attending the *Conversazione* was 1,371.

Proceedings of the Society.

APPLIED ART SECTION.

Tuesday, May 22, 1900; WALTER CRANE in the chair.

The paper read was—

THE PRACTICE OF LETTERING.

By EDWARD F. STRANGE.

In this paper I have no new discovery to bring before your notice, and no new process of study to advise. My subject is that one, next to the faculty of intelligible speech, most intimately bound up with the life of every person of elementary education; and my object in bringing it before this Society is to endeavour to gain some supporters for a movement against certain tendencies of the day, which appear to many of us to be ugly, unnecessary—the terms are almost synonymous—and fraught with great danger to the younger generation of artists and craftsmen.

I need not take up your time with a catalogue of the various faults of most modern lettering. There is hardly a street in which you may not see bad letters displayed with all the frankness in the world; there is hardly a publication in which you will not find type or drawn letters calmly devoid of any pretensions to beauty; there is hardly a public building which does not possess some weakly pretentious inscription in which the carelessness or vanity of the writer is set forth in a way he hardly intended. And my whole object on the present occasion is to try and point out how easily these things might have been better done, and how greatly a little thought, a little modesty, a little good taste would have assisted the makers of these bad letters in the objects they had in view when they produced them.

Now the first element of a cure is to ascertain the origin of the disease. In this case I am convinced that much of the trouble arises from an idea that students and craftsmen seem to be continually getting into their heads that they have to design the letters of the inscriptions on their works. Now that is precisely what they must be warned against. You cannot design a letter. You may burlesque it. You may mutilate it by breaking its back in unexpected places. You may complicate it with weird growths of a more or less fungoid

nature. But you cannot design it, for design implies invention, and no one can be said to invent what already exists; while any attempt to give new forms to the letters in current use can only be compared for audacity with deliberate experiments in the making of new words—I would even go so far as to say—new languages.

For let us consider shortly what the letter really is. It is the accepted medium of intellectual exchange—the current coin of educated civilisation. It bears its value on its face—the form agreed on by the millions who use it. No man may measure the process of imperceptible refinement by which these 26 symbols have arrived at their present state of almost world-wide acceptance. Wherever the Latin races have gone these letters are the daily tools of written intercourse. Wherever the Anglo-Saxon sets his foot he carries with him this great bond that unites him to his fellows. Some nations, indeed, stand out against them; those of Northern and South-Eastern Europe for example. But even among them our alphabets have no little currency, and the adoption of European methods of education in science, art, and literature, is putting a heavy strain on the literary patriotism of Oriental nations—as, for instance, Japan—which are seriously setting themselves the task of coming into line with us.

Now, if a craftsman lays himself out to give a letter a new shape he is paying himself the compliment of asking several hundred millions of persons to accept his image and superscription, instead of that which many generations of themselves have already agreed upon. It would be sublime if it succeeded. But in practice it is simply ridiculous.

I must guard against being misunderstood on this subject. I have said that you cannot design a letter—the form stands. But it must be made absolutely clear that this statement applies only to essential structure. It is impossible for anyone who possesses any individuality whatever, to express himself in any medium without endowing it with character. That may be seen in handwriting, slipshod and utterly bad as most of our scrawls are. If we want to be understood there is always a point beyond which we may not go. However our training, our carelessness, our physical peculiarities may warp them, we must always keep recognisably close to the accepted forms of the written letter; or our purpose in writing fails, we do not convey our thought to the intended recipient of it, we have simply spoiled paper with futile and illegible marks.

But as to character. This means, for us, a certain personal singularity in the making of letters which gives distinction—individuality anyway—to the accepted and still easily understood letter. I would instance to you the types made by William Morris, and especially the Roman type on the basis of that of Jenson. There is nothing to prevent a craftsman from getting his character into his lettering—if he has any—and takes pains enough to develop it. But it will not be done by setting to work as I see so many do, who simply sit down at the last minute to hunt up a convenient model for the hated but necessary lettering: copy it more or less perfunctorily, put in a few eccentricities or excrescences on the spur of the moment, and then wonder why the result does not look well.

So far I have dealt with the abstract drawing of the letter, but there are other considerations of high importance. But before passing on to them, I wish to draw your attention to an example of definite form, which is not only

FIG. 1.

PAGE OF ALPHABET FROM THE "GEOMETRIA" OF A. DÜRER, 1525.

historically interesting but of the greatest practical value. This is the alphabet of square capitals from the *Geometria* of Albert Dürer, A.D. 1525. Each letter is placed in a square, and a relative scale of proportion is worked out to one side thereof. Thus the

thickness of the main shafts of the letters is one-tenth of a side. The great curves are struck from circles nine-tenths of a side in diameter, the smaller curves from circles respectively one-third, one-fifth, and one-tenth of a side in diameter, and the distance of the uprights from the side is generally one-tenth again. Now I know I must face a protest against a mechanical hard and fast rule for the drawing of letters. But the objectors, if such there be, must not too hastily conclude that this example is nothing more. To begin with, it will be seen to be a singularly good alphabet. And a little consideration will show that Dürer—the last man one would expect to tie himself down to a formalism—did not invent the construction to produce the letter; but seeing that the letter was good, worked out the natural law of its excellence, and set it down for the benefit of his fellows. There is no ground for the common habit of looking on Dürer as the originator of it in any sense; for this alphabet with construction is to be found—essentially the same—in nearly all the copy-books of the period. Only one explanation is possible. The form of the letter was, as I have said, practically invariable. Up to the invention of printing it had been a workshop tradition handed on by rule of thumb from master to apprentice. But as soon as a generation had well learned to read, the multiplication and cheapening of printing processes at the end of the 15th century created a demand for the means of learning to write, and the result was the production of the copy-book in the beginning of the 16th century, and the publication of methods which—as my examples, I hope, will prove—were not new; but only now for the first time made easy of access to those interested.

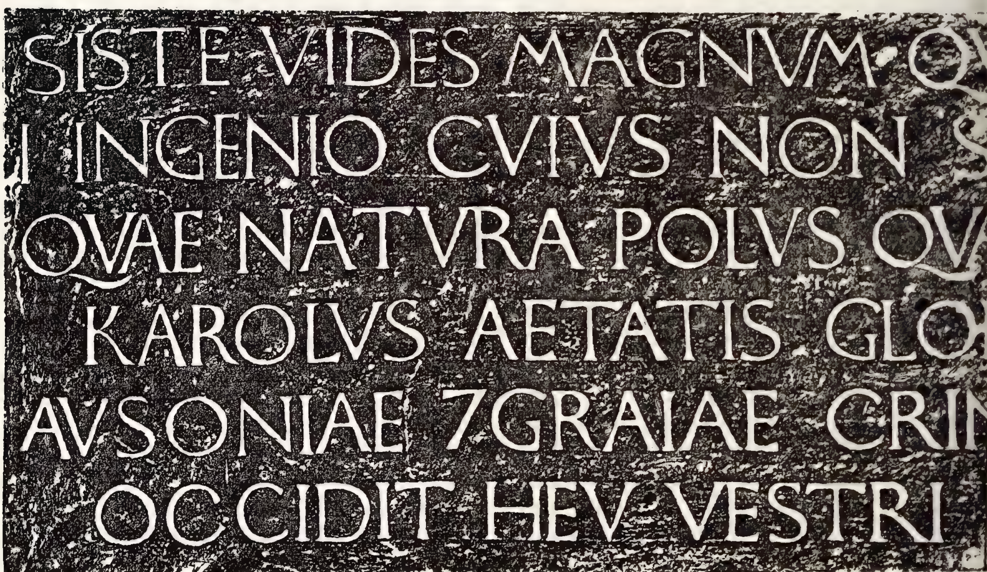
The influence of material on the form of the letter is a matter that the craftsman can only work out for himself. It is impossible to give him rules or teach him his limitations. For the very fact that he is entrusting himself with the making of an inscription implies a mastery of his tools, and if he has acquired a good form of letter those tools will do the rest. Yet it is necessary—with so inconsiderate and light a heart does a man often set about a serious operation—it is necessary to point out one danger. He must not take a style of lettering which is good in one material, and for one purpose, and try to adapt it by brute force to other circumstances. His method of study must be a genuine one, and it goes without saying, somewhat laborious. I can give it in no better words than those used by William Morris in describing the means by which he arrived at the first of the Kelmscott types. Having decided on Jenson's type as his model, he set to work to learn it, "Drawing it over many times," said he, "before I began designing my own letter, so that though I think I mastered the essence of it, I did not copy it servilely." That, indeed, is the crux of the whole matter of learning to make good letters. The essential form of a good model must be acquired till it can be produced without conscious effort, and, as it were, automatically, The personality of the craftsman, and the materials with which he is working, will then re-act on this, giving it interest, beauty, or character, according to his talent.

Before I leave the discussion of the form of letters to deal with one or two points in the application of them, I must needs touch upon a branch of the subject which, to some extent, overlaps both these questions, viz., type. This alone has furnished material for many notable papers which have been read in this room, and it would be impossible—even if it were necessary—for me to treat it adequately in the short space at my disposal. I exhibit a series of examples of type, chiefly for comparison with letters executed under other conditions, and to show what necessary modifications the demands of the printer make on the original form. I need not repeat the well-known qualities of good type: I need not review at length the merits of the early types of Caslon, or of those of Morris. But I do desire to take this opportunity of entering a protest against the fancy types beloved of the compositor, and the uses he makes of them. No age has yet seen such an array of ugliness as is offered by the average advertisement page of a magazine; or the lettering on a bill-head or trade circular. The soul of the printer delights in variety. It is his idea of art. A small octavo hand-bill issued to announce some recent lectures of mine on this very subject, contained no less than thirteen different fonts of type in about fifteen lines of matter; but I did not design it, and was, on the whole, rather glad to have a bad example so easily placed in my hands. Fat, ugly forms, letters shaded to look like masonry, mere shading alone—as it were the ghost of a letter, ornament without backbone; all these are in daily use and very much admired. Some of the recent developments, especially those imported from America, are particularly vile and irritating.

Their designers are indeed well up to the advice given to students by a recent writer on the subject, to "mark what is characteristic in the letter; to develop what is peculiar to it; to curtail, or it may be to lop off, anything which tends to make this confound it with another; to emphasise in short the individuality of each individual letter, and make it unmistakeable." The consequence is that we have letters like H, M, N set upon ungainly stilts; the rotundity of O and C made to cover the meanness of the letter which follows; while the curliness of the tails of those letters which possess them is fearsome and bewildering to contemplate; or else the poor tails themselves are "lopped off." I do plead for simplicity and modesty in letters made for public use. Nothing is more irritating or defeats its own end more thoroughly than an eccentricity in the form of the letters which withdraws your attention from the word which they are used to make. For this is after all one of the greatest faults of the modern maker of letters: he is so eaten up with his ingenuity or phantasy as to forget that his letters are only the elements of what should be a legible announcement.

It should be unnecessary, even ridiculous, to remind craftsmen that the purpose of making letters is to convey information and not to advertise their own dexterity; but the examples of every-day life seem to show the former to be too often the last consideration. The modern poster depends, as a rule, on a design of weird tints, which may or may not be capable of suggesting anything to the beholder save a pardonable desire for colour-blindness. The lettering, very often tied in an inextricable knot, dances drunkenly across a portion of the design: or in great mis-shapen masses makes it top-heavy. No one seems to dare to try the experiment of extreme simplicity: a good, bold, well-chosen letter: spaced with regard to the relative value of the different portions of the announcement and free from any complications of pattern of any kind whatsoever. Yet surely it is one of the highest canons of fine art that beauty and force are dependent upon simplicity rather than elaboration. The fact is that too much attention is given to the letter as a unit. It must be considered in relation to its fellows—the whole alphabet as a whole—for it is only after you have settled the shapes of your letters that your designing begins, when the question arises as to what you will do with them.

Fig. 2.



Rubbing of part of the Inscription on the Monument to Carlo Marsuppini, in the Church of Santa Croce, Florence.

The paper was illustrated by thirty-eight slides, which were described and criticised at this point.

The following is a short summary of the subjects exhibited:—

Sheet of letters with construction from Dürer's Geometria, A.D. 1525.

Inscription from the base of the Trajan Column, A.D. 114. Actual height of the letters, 4 inches.

Inscription on the monument of Henry VII. of Luxembourg, by Tino da Camiano, A.D. 1315, in the Cathedral at Pisa.

Inscription on the monument to Carlo Marsuppini, by Desiderio da Settignano (1428-64) in the Church of Santa Croce at Florence. (See illustration, Fig. 2.)

A series of alphabets of Roman Capitals engraved in type-metal, etched on copper, in modern types (Chiswick Press), and from an Italian MS. of the 15th century illustrating the permanence of the actual form of the letter from the earliest times, and the modifications induced therein by the use of different materials.

A series of lower-case letters on similar lines.

An inscribed slab to the memory of Guillaume de la Bampoele, A.D. 1559: with the ground cut away to leave the letters.

Italic of Aldus compared unfavourably with italics of Caslon and Chiswick Press, as type.

Specimens of print by William Morris, D. B. Updyke, of the Merrymount Press, Boston; Caslon, Jenson, and Aldus (Poliphilus).

Specimens of 16th century writing, with a quill or reed pen.

A sheet of a MS. Service Book, written at Worcester in the 13th century. Title-pages by B. Rembolt (Paris, c. 1498), Manfredus de Montis Ferrato (Venice, 1516), and Gleeson White, illustrating possibilities of obtaining good design with type-letters and printers' ornaments.

Specimens of simple lettering used in connection with fine works of art, viz.:—

Side of the font in the Church of S. Giovanni, Siena, by Jacopo della Quercia, 1430.

Panel from the staircase of the pulpit in the Cathedral, Siena, by Francesco Tolomei, 1543.

Bust of Onofrio Vanni, by Benedetto da Maiano (d. 1498).

Inscriptions on Della Robbia ware.

Inscriptions on bronze.

Medal of Malatesta, by Vittorio Pisano (c. 1443).

Painting (one of the Perseus series), with Latin inscription, by the late Sir E. Burne-Jones (by permission of F. Hollyer, Esq.).

In conclusion, the examples I have laid before you cover, necessarily, a great deal of ground. They were prepared for a lecture which I have had the honour of delivering to several of the schools under the Technical Education Board of the London County Council, and I used them rather as a series of texts for little homilies than as complete evidence in support of a definite case or contention. In speaking to an audience composed entirely of students and craftsmen one is justified in enlarging considerably on the importance of the work they are doing. There is a danger of the craftsman taking too personal a view of his occupation; and of forgetting that he is working for other people. I am far from suggesting that in remembering the claims of the public, he need necessarily lose one atom of his independence or individuality. But if he is making an object for use, and not with the single idea of giving abstract pleasure, he must consider the user, or he will fail.

Now this is especially the case in the making of letters. The craft is not to be lightly laid aside as a mere appendage of another art. It is the easiest thing in the world for an artist who has made a fine work of art, a medal, a piece of sculptured decoration—anything you will—to spoil it utterly by the badness of the inscription. For human nature is such that it cannot forgive so obvious a fault; the very label, as it should be, of the perfection of the handicraftsmanship. It is easy to make a great church or public building appear indescribably mean by the badness of the lettering displayed on it; while nothing can be more decorative or dignified than a well-proportioned, simple block of lettering in its right place.

The makers of letters, whether in the arts or books, must take themselves more seriously. They must realise the greatness of the audience to which their works may appeal, and divest themselves of little personal eccentricities accordingly. And how great and splendid that audience may be if the lettering only rises above the petty fashions in ornament that live but for a day or two, may be suggested to you by a remembrance of that inscription from the base of the Trajan Column. Millions of passers-by have been able to read those words as easily during eighteen hundred years as if they had been carved yesterday. And no single designer, nor the aggregate influence of all the generations since, has been able to alter the form, add to the legibility, or improve the proportion of any single letter therein. That is my case.

DISCUSSION.

The CHAIRMAN said Mr. Strange had made out a very good case for the preservation of the Roman alphabet according to its best traditions, in which all

the proportions of the letters were properly observed, as shown in the extremely interesting series of illustrations, while still allowing a certain amount of liberty to the individual artist in their treatment. As he had said, you could not design letters in the sense of reconstructing them, but every artist who had occasion to introduce letters must, in a sense, re-design them for himself. This re-designing came in obviously in the spacing, by the aid of which you got an entirely fresh feeling in a design of lettering though it was based on the old elements. One reason why such respect was due to these forms was that they were really crystallised pictographs or hieroglyphics, which once represented some compact symbol or emblem; in process of time the unessentials were shed and the essential lines preserved sufficiently for identification, and it was impossible to proceed further in the direction of abstract line and form. These symbols could not be maltreated or caricatured without losing their meaning; but they furnished the artist with an extremely valuable element, enabling him by contrasting their severe, simple lines with the more rich and varied portions of his design, to obtain a dignity and impressiveness which nothing else would give. In Rome, largely owing to the preservation of the tradition of the style of the old inscriptions, the names of the streets were all written in clear, open, Roman capitals, in black on white tablets, the same sized letters being used throughout the city, which was a great convenience. The English were supposed to be a practical nation, but in London the names of streets were in some places obliterated by the smoke, and in others were presented in staring white letters on a blue ground, which seemed to be the favourite style of late, but there was no uniform system; though this matter might be managed not only so as to be useful, but to add to the artistic dignity of the street architecture. Of course it was too much to expect such things to be attended to in a city which allowed every street to look ridiculous by exhibiting signs of all sorts and sizes; huge letters, 6 ft. high, being fastened by iron rods in front of windows and other architectural features. The same plague followed one at the railway stations, where one would have thought it was desirable to be able to recognise the name instantaneously, but it was often quite a puzzle to find it at all amongst the numerous strange legends clamouring for attention, many of them in the same size and style of lettering as the name of the station itself.

Mr. J. PENNELL said he thought that wonderful design of Dürer's, in which he gave the proportions of letters, was very much like his design for drawing the human figure in certain proportions, but it had been pointed out that nobody, except Albert Dürer, could ever find out what the proportions were. He had worked at that scheme himself, but never found out where the proportions came in. If Mr. Strange had solved the problem, he had done what no one else had ever done before. He quite agreed with the Chairman that the form of the letters could not be changed, it was simply a question of arrangement. If lettering was not legible it was useless—the Roman letter was both legible and useful and also beautiful; and the nearer they kept to it the better. He should like to know where Mr. Updyke got the design of his type from; he believed he was only a publisher, not a designer, or even a printer. He had an idea that the specimen shown was one of Mr. De Vinne's founts; at any rate, it was extremely like it, and he was sorry Mr. Strange had not shown some of De Vinne's Roman types, which were about as good as anything done in America. As to the barbarisms which had been referred to, it was quite true they were made in America, but it apparently was for the English market; they were imported and seemed to be liked here. Only a year or two ago, at St. Bride's Institute, where the County Council had a printing class, he saw a row of utter abominations, mostly of American letters, for which prizes had been awarded. In fifteen lines there were 15 founts of type used. He would ask if Mr. Strange was sure that the writing shown on one of the slides was done with a quill, because he had noticed in the City that it was now common to use for lettering on large packing cases a particular kind of square pen having a series of steel blades (made, he believed, by Wolff), which gave admirable results in broad lines. It was far superior to a quill, and would be of great service in art schools.

Mr. H. B. WHEATLEY said one great value of the series of slides Mr. Strange had shown was to demonstrate the beauty of the Roman alphabet, a point often forgotten because of its familiarity. If an inscription had to be put up in a church or elsewhere, it was too often put in Gothic character, or some unreadable form. Unfortunately, with Gothic inscriptions, the letters were often defaced by inappropriate ornament, which sometimes made it almost impossible even for those accustomed to the old manuscript forms to decipher them. Where the Roman alphabet was used, you found you had a series of most beautiful letters, which were always quite clear; and, in the case of initials, although there might be a large amount of ornament, it was always subsidiary to the form of the letter. This could not be said of Gothic, where the form was often lost in the ornament, as in the case of many old German books. Mr. Strange had been, perhaps, a little hard on the italic type of Aldus, the imperfections of which were magnified in the lantern. We did not want books printed entirely in lower-case italics, but one did get occasionally a very beautiful effect from italic capitals as headings. With regard to title pages, that to Mr. Strange's book was an exceedingly good example, and what was said with regard to the late Mr. Gleeson White must be understood by all who had tried to make an original title page. The ordinary

title page was as inartistic as it could be, and anyone who wanted to get a really good artistic title page had much difficulty in making the printer understand his ideas. One of the points especially to be noted in the particular title page shown on the screen, was the use of lower case letters, but up to a very few years ago you could hardly get a printer to use lower case in a title page; it was used in France very effectively, but in very few English books. With regard to the Morris type he was rather struck lately with an instance, showing how very wide the influence of Morris was abroad. He happened to see a series of the addresses sent over from German universities to a distinguished Englishman a short time ago, and in many of them where you would expect an ornate Gothic letter there were evident imitations of the Morris lettering, and this he thought was specially interesting.

Mr. C. T. JACOBI said he could cordially support Mr. Strange's denunciation of the monstrosities that came over from America occasionally. The bulk of them were fearfully and wonderfully made, and only fit for the metal pot. Mr. Pennell had referred to Mr. Updyke's service book, and he believed that Mr. Updyke was the means of designing that particular book, but who designed the actual type he could not say, though there was no doubt it was largely inspired by the Morris fount. He believed Mr. De Vinne actually printed the book. He quite agreed with Mr. Strange about the various types in use in magazines, a large proportion of which could be dispensed with. The specimens of Roman type he had shown from the Trajan column and onwards to the present time could not be improved upon. Artists often came to the Chiswick Press and asked for a good alphabet as a pattern, and he did all he could to help them and to suggest to anyone who was working at lettering, to cultivate at first a plain sanserif letter, which were about the best model they could take as a pattern. When they attained experience they could put the serifs at the top and bottom, or any other little improvement, but they must not go too far from the original model. Some very good specimens of lettering were to be seen in the removal notices in the Inns of Court, which seemed almost as if they were done by one family of artists. They were written in plain lower-case and capitals, very much after the style of the Caslon type. As an instance of how not to do it, he might refer to the brewers' signboards to be seen in every street. Some of them were very cleverly executed, but the form of the letters was often very inaccurate, and very similar to the fancy type often used for advertisements in magazines. He was glad Mr. Strange had referred to the Poliphilus, which was really one of the most beautiful specimens of typography he had ever seen. From an artistic point the colour all the way through was beautiful, and the chapter heads and capital initial letters were all thoroughly in harmony. Some years ago he was struck by some large bills that appeared on the hoardings emanating from some firm of City printers, termed Types of Beauty, which he thought at the time was the most incongruous set of letters he ever saw.

Mr. STRANGE, in reply, said it could not be made too plain that one did not design the letters, but designed *with* the letters, which made all the difference in the world. The letter was the element with which the artist had to work, and there was no limit to the power of producing beautiful things by the arrangement and re-arrangement of those 26 simple letters. Speaking only of the Roman alphabet, there were beautiful forms in some of the lower case letters, and some of the Lombardic forms, which were still intelligible, were also beautiful. It was as serious a thing for a man to learn to design with letters as to design anything else. With regard to Mr. Pennell's remark about the Dürer alphabet, there was no difficulty whatever in making out the proportions in the measured alphabet, and they were published by other people at least twelve years before Dürer, and by people who probably never heard Dürer's name It was not a thing invented by him, but was in current use throughout Western Europe at the time. And the proportions were pretty easy. They were simply a recipe for producing a letter, the proportions of which had already been found beautiful. He did not see any reason why a circle should be in diameter 9-10ths of the side of the square in which it is placed, except that it was found to give a good curve in proportion to the height. With regard to the Updyke letters, he did not know who designed them. Mr. Updyke sent him the pages a few months ago as specimens of a new fount he had had made, and they were printed at the Merrimount Press, Boston. He had written to ask the name of the designer of the letters, and would make it known as soon as he got the information. There were several good pens, much more convenient to work with than a quill or reed, which were generally found in the hands of packers and warehousemen, and not sufficiently known in schools of art. There was one tool in common use by packers, hardly known at all outside their ranks, viz., a simple stick of soft deal sharpened to a particular kind of point; you could get exactly the amount of flexibility you wanted, and do remarkably good work with it. Some of the eccentric letters produced were amusing, but it was a pity to waste ingenuity upon them. The more a letter departed from the standard the more useless it became. He should certainly take an opportunity of looking at the removal notices Mr. Jacobi had referred to. There was a great deal of quiet, unostentatious craftsmanship in the way of lettering which was entirely overlooked, and no credit given for it. You would sometimes find in a village churchyard a whole series of beautifully written inscriptions ranging over a period of 20 or 30 years.

He would conclude by paying what tribute he could to the value of the services rendered in this matter by William Morris. He was not speaking of the merit of the types he produced, but Morris was the most prominent man in modern times who condescended to sit down and seriously study lettering and work at it. The production of these types was not his only essay in that direction. He taught himself to write in the style of the old MS. writers, and did so with a beauty equal to that of many of the 13th or 14th century specimens. In everything he did he was very thorough, and in lettering especially he saw at once what many forgot: that it was not a trivial, unimportant thing, but one to be taken seriously, under penalty of spoiling all the other work connected with it.

The CHAIRMAN then proposed a vote of thanks to Mr. Strange, which was carried unanimously.

Miscellaneous.

BROWN COAL MINING IN THE RHINELAND.

In recent times Rhenish lignite, or brown coal, mining has attracted in a high degree the attention of Cologne and Rhenish capitalists and business men. The Rhenish brown coal has its centre in Brühl, which lies halfway between Cologne and Bonn, on the slopes of the so-called Vorgebirge (or lower range) and situated at a distance of about 9 miles from Cologne, its extremities reaching to within about 3½ miles from Cologne. Brown coal mining in this locality had been carried on for a long time, as is attested by documents from the middle of the 16th century, but it never acquired any importance. Only within recent years have these mines and the working of their products attained a commercial importance hitherto undreamed of. According to the British Vice-Consul at Cologne the causes leading to this were: (1) The introduction of the working up of the raw material into compressed coal and briquettes. The coal, which is but of light specific gravity, is compressed into a handy form by means of presses. In this way it has become possible to reduce bulk for transport; formerly the coal could be utilised only in the immediate vicinity. In this shape it is converted into an article of export beyond the Rhineland to countries which are dependent on wood or turf for fuel, such as Switzerland, the Netherlands, and even Italy. (2) There exists in the Rhenish brown coal district a whole network of so-called *Kleinbahnen* (light railways), some already completed, others in course of construction, which are in connection with the industrial works and with the Prussian State railways. (3) Wire rope high level railways have in many places been constructed, which convey the uncompressed lignite coal direct from the mines to the works using it as fuel. (4) The rise in the price of mineral coal has conduced to the increased consumption of lignite, which latter is obtained by the simplest surface mining system under conditions more favourable than anywhere else. Added to this there is the technical improvement in the construction of furnaces, bringing about a better method of using this coal. Rhenish brown coal mining has become a factor in Rhenish industrial life, which will henceforward have to be reckoned with. Realising the economical advantages offered in the Cologne district to it, several large manufacturers, more especially those of sugar, of chemicals, of earthenware pipes, &c., have adopted it as fuel, some adopting the furnaces thereto, others constructing them from the first to suit the coal. In the circles interested, a greatly increased prosperity is anticipated in brown coal mining and in the manufacture of briquettes connected with it, but more particularly of the large industries in the Cologne district generally. The quantity of brown coal, about 3,000 million tons, contained within the limited district of the Vorgebirge (or lower range) affords a guarantee of moderate prices, so that an extraordinary development within the district in question may reasonably be expected. It is said that no more suitable locality for the erection of works requiring large quantities of fuel could be named than this same brown coal district, especially as within a short time it will be connected by ligh railways with Germany's most important waterway, the Rhine. In addition to this, there exist large valuable deposits of clay for manufacturing purposes, and wages are low. New works, pottery factories, glass factories, linoleum works, &c., are continually springing up. With regard, in the first place, to the geological fact of the presence of brown coal in the Rhineland, it is found there resting on a bed of Devonian formation which extends widely on both sides of the Rhine, a far-reachiug basin of tertiary formation. This basin is filled up with deposits of oligocene, the middle strata of this formation, to which the brown coal measures belong, being mostly covered by later deposits belonging to the quaternary, *i.e.*, diluvial and alluvial periods. Brown coal itself owes its existence to a sub-tropical flora, consisting partly of marsh plants, partly of tree and shrub-like vegetation, in the same way as the enormous swamps of Florida, now in process of formation. Remains of this flora are found in bituminous wood or lignite impressions of fruits and leaves, for example of alder, oak, beech, poplar, hazel, fig, laurel, palms, &c. How exuberantly profuse this vegetation must have been is shown by coal being met with of a thickness of 5 to 30 yards on the eastern slope, beneath a layer of gravel of from 1 to 13 yards in depth; on the western slope of a thickness of from 16 to 104 yards beneath a 4 to 25 yards layer of gravel. The brown coal found here consists chiefly of solid coal, in which particles of

wood, bituminous wood, tree trunks, sometimes horizontal, sometimes perpendicular, are embedded, and in the uppermost layer mostly of earthy, rather clayey brown coal—the so-called *Schmierkohle.* The basin in question of the oligocene period commencing in the south at the Seven Mountains and spreading itself out northwards in the flat lands between the mountains of the Eifel and the Bergisch district, is divided by the ridge of the Vorgebirge, which attains a height of 420 feet above North Sea level between Godesberg and Bergheim for about 22 miles, into a western part traversed by the Erft Stream and an eastern part in which the Rhine Valley lies. Both parts seem to unite further north. At a very moderate average computation of its thickness, the mass of brown coal contained in the Lower Rhine tertiary basin may be reckoned at a quantity which cannot possibly be exhausted within any measurable period. The thickness of the oligocene bed is naturally least at the edges of the basin and at its extremities, but increases towards the centre and after its dip towards the north. It amounts, for example, near Brühl, as proved by a boring there, to more than 325 yards, and towards the north it is certainly still greater. In addition to the coal, the oligocene deposits contain valuable clays, also shale coal or dysalyl, formerly worked for mineral oil and paraffin, likewise alum clay and clay iron ore, the production of which, however, has been discontinued. The coal is won almost exclusively in ordinary open surface mining at a relatively small cost, the layer covering it being only 10 to 15 yards thick. It is utilised, partly, simply as unpressed brown coal, and partly, after being ground, dried, pressed into handy form, and shaped into briquettes, as household coal. It is expected that the manufacture of briquettes will shortly exceed 1,000,000 tons annually.

LIEGE SCHOOL OF FIREARMS.

There is established in Liege an industrial school known as the "Ecole Professionnelle d'Armurerie," founded in 1896 by the city, the government, and the province, where thorough instruction is given in the manufacture of firearms. The complete course covers a period of three years, and is divided into theoretical and practical. The theoretical covers drawing, lectures on the strength and combination of steel and iron, &c. The practical consists of several departments, such as wood-working, engraving and polishing, each presided over by a competent instructor. Tuition is free, and in addition the pupil is paid 25 centimes (about 2½d.) per day, and on completing his course receives a sum equal to 25 per cent. of the sales of his finished work. The school opened with eight pupils, and at present has 115 in the different departments, which is its limit. Arrangements are almost completed for materially enlarging the buildings during the present year to provide accommodation for more than 200. Pupils from this school have no difficulty, according to the United States Consul at Liege, in securing positions at good wages. The important position occupied by the school will be realised when it is understood that about 30,000 persons in Liège alone and its immediate vicinity are employed in the firearm industry. The object of the institution is to qualify workmen for responsible positions in the different factories, since for the past few years nearly all are employed on piecework, which does not fit men for positions requiring a general knowledge of the business. This put the manufacturers at a great disadvantage, as it was becoming nearly impossible to secure competent foremen and superintendents of departments. For several centuries the manufacture of firearms has been the leading industry of Liège, and its vicinity and the city maintains an interesting museum of firearms. It is worthy of note that several thousand of the old flintlock guns are still manufactured every year at Liège for the trade in the interior of Africa, the natives preferring them to the modern guns.

RESOURCES OF SIBERIA.

At a conference held recently at Lyons on the resources of Siberia and its possible competition with cereal producing countries, an interesting paper was read by M. Emile du Marais, a civil engineer who has passed many years in Russia, and is a member of the Russian section of the French Bureau of Foreign Commerce. He said that 200,000 farmers arrive in Siberia annually, the Government providing them with free transport, and giving each family the free use of 15 hectares (37½ acres) of land for a stated time. The population is now 8,000,000. Making a computation upon the basis of the population of Russia in Europe, Siberia is capable of sustaining a population of 80,000,000. The annual production of cereals in Siberia is 20,000,000 metric quintals (2,000,000 tons), of which 6,000,000 to 8,000,000 quintals (600,000 to 800,000 tons) are exported. The country can produce 10,000,000 tons annually, from 4,000,000 to 5,000,000 tons of which are subject to exportation. Siberia now exports butter to Denmark. It is estimated that she can export annually 80,000,000 francs' (£3,200,000) worth of butter, wool, leather, dried and preserved meat; and fish and tallow may figure conspicuously in her efforts in the near future. A movement is now in progress in the direction of forest preservation, the destruction having caused a scarcity of furs, blue fox, and zibelines. Siberia produces one-tenth of the world's yield of gold, and but few of the mines have been worked on account of the climate. The immense coal deposits have hardly been touched. M. du Marais, according to the United States Consul at Lyons, stated in his paper that one mine with six beds contains as much coal as all the deposits in England. The lack of transporta-

tion facilities alone has prevented it from being worked. The Trans-Siberian Railway, from an economic and political standpoint, is the greatest work of this century. It now touches the Amur, and in three years it will reach Port Arthur, making the distance but thirteen or fourteen days from Moscow to Pekin. There is annually an excess of 1,500,000 births over deaths in Russia, and Siberia is the outlet for this overflow. The black lands of Siberia form an area of not less than 50,000,000 hectares (123,500,000 acres), but high freight rates are an obstacle to the arrival of their cereal products in France.

PREVENTION OF RAILWAY ACCIDENTS IN RUSSIA.

Experiments have been made at the Vershbolovo Station, on the St. Petersburg and Warsaw railway, with an invention of M. Nikolaieff, designed both to give warning and to lessen the deadly effects of railway collisions. The United States Commercial Agent at Vladivostock, in a recent report speaking of these experiments, says:—"Two wrecking railroads were provided—on the first, the sleepers were displaced; on the second, the rails were displaced. In both cases the stoppage was immediate by the aid of the device, without outside assistance, and without injury to the moving trains. The essential feature of the invention is an iron tube of usual construction, connected with the general system of brakes placed in front of the wheels. At the least irregularity in the movement of the train, the tube in consequence of certain cuts made on it at intervals breaks, and thus produces an immediate stoppage of the train—locomotive as well. The examining committee found that the tube fully accomplished its purpose. Such an invention is of the greatest importance in Russia, where railway accidents are of frequent occurrence. According to the official statistics the number of fatal railway accidents in 1893 was 4,548; in 1895, 5,763; in 1896, 6,107.

General Notes.

PORTRAITS OF THE COUNCIL.—The *Graphic* for this week contains a picture of a meeting of the Society of Arts Council, from a sketch by Mr. Sydney P. Hall, taken on the occasion of the Council meeting of the 30th of April. The following are the names of the members who were present, and whose portraits appear in the group:—Sir John Wolfe Barry, K.C.B., LL.D., F.R.S. (Chairman), Sir Frederick Abel, Bart., K.C.B., D.C.L., F.R.S., Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Lord Belhaven and Stenton, Sir George Birdwood, K.C.I.E., C.S.I., Sir Frederick Bramwell, Bart D.C.L., F.R.S., Major-General Sir Owen Tud Burne, G.C.I.E., K.C.S.I., Mr. R. Brudene Carter, F.R.C.S., Mr. B. Francis Cobb, Mr. Lew Foreman Day, Sir John Evans, K.C.B., F.R.S Mr. Joseph G. Gordon, Mr. Henry Graham Harri Sir Charles Malcolm Kennedy, K.C.M.G., C.B the Master of the Rolls, G.C.M.G., Sir Williar Henry Preece, K.C.B., F.R.S., Sir Walter S Prideaux, Sir Owen Roberts, M.A., D.C.L., F.S.A Mr. William Luson Thomas, R.I., and Professo John Millar Thomson, LL.D., F.R.S., with Si Henry Trueman Wood (Secretary) and Mr. Henr B. Wheatley (Assistant Secretary).

BYRON MEMORIAL IN HOLLES-STREET.—In 186 the Society of Arts placed a memorial tablet to Lor Byron on the house 24, Holles-street, where the poe was born in 1788. The original number was 16 which was subsequently altered to 24. The hous was pulled down in March, 1889, and the tablet wa not re-erected on the new house, which forms part o the establishment of Messrs. John Lewis and Son silk mercers. In May of the present year, however Messrs. Lewis erected on the front of the house a fresh memorial consisting of a bronze relief bust o Byron placed in an architectural frame of Portland stone. The bust is an excellent likeness of the poet and is taken from a proof engraving of the painted portrait at Newstead Abbey, the sculptor being Mr. Taylerson. This memorial was uncovered on May 14.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 25...Geographical, University of London, Burlington-gardens, W., 8½ p.m.
British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, JUNE 26...Photographic, 66, Russell-square, W.C., 8 p.m. Mr. J. H. Agar Baugh, "The Selection of Senses with regard to Photographic Perspective."

WEDNESDAY, JUNE 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.
Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 10 a.m. General Meeting. 1. Prof. H. S. Hele-Shaw, "Road Locomotion." 2. Mons. Edouard Sauvage, "Recent Locomotive Practice in France." 3. Prof. C. A. Carus-Wilson, "Polyphase Electric Traction." 4. Mr. Bryan Donkin, "Observations on an Improved Glass Revealer for Studying Condensation in Steam-engine Cylinders and rendering the Effects Visible."
United Service Institution, Whitehall-yard, S.W., 3 p.m. Rev. E. Warre, "The Relations Between Public Secondary Schools and the National Defence of the Country."
Royal Society of Literature, 20, Hanover-square, W., 1 p.m.
British Astronomical, Sion College, Victoria Embankment, W.C., 5 p.m.

THURSDAY, JUNE 28...Mechanical Engineers, Storey's-gate, S.W., 10½ a.m. (Indian Section.) General Meeting continued.
Hellenic Society, 22, Albemarle-street, W., 5 p.m.

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FRIDAY, JUNE 29, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

In future the Society of Arts Examinations will consist of Three Grades.

I. Preliminary or Junior.
II. General or Intermediate.
III. Senior.

[It is not proposed to hold an examination in the Senior Grade in 1901.]

Full information respecting the Preliminary Grade with the Syllabuses will be found in the number of the *Journal* for June 15 last. Separate copies of the Syllabus can be obtained on application to the Secretary.

The next examinations will be held in March, 1901. The precise date will be hereafter announced.

The results of the examinations held at the end of last March will be published in a few days.

Proceedings of the Society.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers, was held in accordance with the By-laws on Wednesday last, the 27th inst., at 4 p.m. Sir John Wolfe Barry, K.C.B., LL.D., F.R.S. (followed by Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.), in the chair.

The Secretary read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, balloted for, and duly elected members of the Society :—

Anson, Sir William Reynell, Bart., M.P., D.C.L., All Souls' College, Oxford.
Apcar, Apcar Alexander, 11, Russell-street, Calcutta, India.
Bohn, Henry Arthur Godson, 17, Holland-villas-road, Kensington, W.
Butler, Arthur, British Residency, Pahang, Straits Settlements.
Calderon, Guillermo R., 46, Queen Victoria-street, E.C.
Dorset, Rev. Frederick W. Barrow, The Rectory, St. Andrew's, Grenada, British West Indies.
Ghine, Moung Ohn, C.I.E., 26, Lewis-street, Rangoon, Burma.
Gladstone, Henry Neville, 4, Whitehall-court, S.W.
Hayward, F. D., 9, Gracechurch-street, E.C.
Hoghton, Captain Frederick Aubrey, United Service Club, Simla, Punjab, India.
Jacob, Lawrance, The Lodge, Randolph-crescent, Maida-hill, W.
Jarman, Arthur, The University, Sydney, New South Wales.
Markham, Walter E., 79, Essex-road, N.
Muhammed Khan, Khan Bahadur Yar, C.S.I., Jaora, Central India.
Murti, P. N. Krishna, C.I.E., Bangalore, Mysore, India.
Nixon, Major-General John Pigot, care of Messrs. Henry S. King and Co., 45, Pall-mall, S.W.
Pignatorre, George, Messina, Sicily.
Richmond, E. W. T., 132, Queen Victoria-street, E.C.
Rose, George Pringle, C.I.E., care of Messrs. H. S. King and Co., 45, Pall-mall, S.W.
Salter, William Henry Gurney, 26, Abingdon-street, Westminster, S.W.
Sankey, Charles Herbert, Essex Wharf, Canning Town, E.
Singh, Kunwar Kushal Pal, M.A., LL.B., Kotla, P.O. Kotla, Dt. Agra, India.
Vincent, Sir William, Bart., D'Abernon Chase, Leatherhead, Surrey.
Watkins, W., 83, Mortimer-street, W.
Wertheimer, Alfred, 8, Connaught-place, W.
Whiting, James Edward, M.A., Poona, India.
Whittaker, John, J.P., Brookside, Wilpshire, near Blackburn.
Williams, Edward, 127, St. Domingo-vale, Everton, Liverpool.
Wood, Reginald, Fen Moor, Bottisham Lode, Cambridgeshire.

The Chairman nominated Surg. Lieut.-Colonel J. Ince and Mr. John Jewell Vezey, scrutineers, and declared the ballot open.

The Secretary then read the following

REPORT OF COUNCIL.

I.—Ordinary Meetings.

In the address with which, as Chairman of the Council, Sir John Wolfe Barry opened the 146th Session of the Society, he further developed the subject which had formed the material of his previous address—the communications of London—and gave in some detail plans by which the two great streams of traffic, one north and south, and the other east and west, could be carried across one another without interference.

At the first meeting after the Chairman's address, Mr. Hutchins, Conservator of Forests at Cape Town, read a very suggestive paper on "National Forestry." Mr. Hutchins's experience of forest work in India and at the Cape led him to believe that landed proprietors in England are neglecting a valuable source of revenue in not paying sufficient attention to the growth of timber in England. He contrasted the condition of forestry in this country with that which it holds on the Continent, and showed that there are large areas in the British islands from which a safe, if not an immediate, revenue could be obtained by planting trees. In his opinion the subject was one well deserving the attention and the financial support of Government.

The next paper was by Mr. Allan Wyon, whose family has long been associated with the Society, all the medals issued by the Society for a long period past having been produced by himself or by his predecessors in business. It consisted of an interesting historical account of "The Great Seals of England," tracing their history from the earliest seal known—that of Offa, King of Mercia, of the date of 790—down to the present time. The paper was throughout fully illustrated by slides showing a selection of some of the most important or beautiful seals.

In the next paper Mr. Joseph Cash gave an account of the progress which has been made in the manufacture of artificial silk—a manufacture which is now assuming important proportions. Although artificial silk is not yet capable of being used for the warp, there appears to be no doubt that it can advantageously be used to a very large extent for the weft in the production of goods of a very high class. In the discussion the Chairman, Sir Thomas Wardle, pointed out that the introduction of the new silk substitutes had not had any effect whatever upon the demand for real silk, the value of which was rising, anc threatened to rise still further.

In the following paper, Mr. Aflalo discussec the question of "Sea Angling and Legislation,' and argued that the destruction of immatur fish by sea anglers—that is to say, persons wh fish for sport rather than for profit—was quit sufficient to justify legislative control. Late on in the session another angling subject wa dealt with by Mr. J. W. Willis Bund in a paper, read in the latter part of May, o "Salmon Legislation." Despite all the atten tion which has been given of late years t the preservation of salmon, Mr. Willis Bun demonstrated that further protection is stil required for the fish, and further limitation o the times and methods by which salmon i taken at the mouths of rivers, if the stock o fish in British rivers is still to be preserved.

At the last meeting before Christmas, Mr H. Bloomfield Bare read a paper on "Bi Manual Training by Blackboard Drawing" Mr. Bare's object was to introduce into thi country the method of teaching drawing whic has been successfully cultivated by Mr. Tad in the United States. In this the student i taught to draw on a large scale, and with bot hands, on the blackboard, and facility i striking large and flowing curves is an im portant point in the system. The gener tendency of Mr. Tadd's system is very simila to that which is being so strenuously promote by Mr. Ablett and the Royal Drawing Society Both alike regard drawing not only as a branc but as a means of education.

The first paper after Christmas was a usef and practical one, by Mr. Arthur Rigg, on th general question of "Ventilation." His view in general were that, as far as possible, vent lation could be more satisfactorily effected b forcing the air into a room than by exhaustin it; that fresh air should be introduced in a upward current at openings above the hea of the audience; that the exit openings shou be near the floor level; and that necessa fans, furnaces, or other means of producin artificial draughts should be employed.

The following week, Mr. W. O. E. Mead King dealt with another hygienic subject, i his paper on "Local Government and its r lation to Parish Water Supply and Sewerage —a paper which dealt with the sanitation small towns, villages, and country district rather than with that of cities and large town A fortnight later, Mr. Edmund Wilson treate another important health subject, "Th Housing of the Working Classes." M

Wilson's paper was specially important, in that it dealt with the problem from a provincial standpoint, as it gave an account of the measures which had been taken in Leeds for the improvement of workman's dwellings—measures perhaps less applicable to London than to provincial centres, but none the less important on that account. Yet another paper dealing with a subject which concerns the health of the people was that read a few weeks later by Dr. Samuel Rideal, his subject being "The Use and Abuse of Food Preservatives." The tendency to add various materials to articles of food supply for the sake of their preservation is a growing one, and it seems as yet rather uncertain how far such additions, even in small quantities, may, or may not, be deleterious. Dr. Rideal's paper, which gave the results of a great deal of research into a difficult and complicated subject, will be found to be of considerable value in providing information from which conclusions on this important question may be drawn.

During the session three important papers were read on the resources of various foreign countries. At the end of January, Sir Martin Conway gave an account of "Some of the Undeveloped Resources of Bolivia," the result of his observations when recently engaged in a mountaineering expedition in that country. In March, Dr. Carl Peters, the well-known African traveller, gave an account of the district south of the Zambesi, known as Macombe's country, a district which he was inclined to identify with the ancient Ophir of the Scriptures. And in the last paper read during the session, Mr. A. R. Colquhoun described the present condition of that portion of Central Asia lying on the borders of Russia, Persia, and Afghanistan.

Professor Wood, who came over from America for the special purpose, described in a paper on "The Diffraction Process of Colour Photography," the very original and ingenious method which he has devised for reproducing by photographic means the natural colours of objects. Whether the process will ever come into practical application may be considered doubtful, but there can be no doubt as to its ingenuity and its scientific beauty. It is true that Prof. Wood has not quite rivalled Prof. Lippman, who alone has succeeded in reproducing natural colour by purely photographic means, without the intervention of coloured screens or other similar devices. The original negatives from which Prof. Wood works must be obtained by the use of Ives's or some other trichromatic process. But, using such negatives, which in themselves show no colour, he is able, by his use of diffraction gratings, differentially ruled, to produce photographs which, viewed by a lens, and with transmitted light, reproduce with approximate accuracy the colours of the originals from which the negatives were taken.

Mr. Edwin Bale, in his paper on "Artistic Copyright," dealt with a subject which has long been very closely associated with the Society of Arts, since it was by the action of a Committee of this Society that copyright in works of fine art was first secured in this country. His paper dealt especially with the Copyright Bill which is now before the Legislature, and the reforms which were specially required by artists for the protection of their works. In the discussion a vigorous remonstrance was made on behalf of photographers against the way in which their rights were proposed to be limited.

Professor Charles A. Carus-Wilson, in his paper on "Pneumatic Despatch," gave an account of the attempt which is now being made to render useful the line of pneumatic tube laid down many years ago in London, and to further develop and extend the method.

Mr. H. Macan's paper on "Continuation School Work in Rural Districts" showed what had already been done in the provision of elementary technical instruction throughout the country, and urged that the Education Department should treat continuation schools in a more liberal spirit than it has done hitherto.

Mr. Douglas Cockerell, in his paper on "Leather for Bookbinding," gave an account of the work which had been done by the preliminary Committee on this subject, and showed how much there was for the Committee appointed by the Society of Arts to do. He made it clear that the leather now obtainable for bookbinding leaves very much to be desired, and that it compares very unfavourably with the material at the disposal of the older bookbinders of a few generations ago. To investigate this question and to suggest a remedy was the work for the Society's Committee, the appointment of which was due in no small extent to Mr. Cockerell's exertions.

Mr. John A. Banister, in his paper on "Cotton Supplies," condensed into a very convenient form the results of much study of recent statistics, and gave a very useful

account of the sources from which the cotton supply of this country is provided.

Miss Ethel Halsey, under the title of "Some Unfamiliar Masterpieces of the Italian School," gave a very clear and interesting account of a number of works of Italian masters scattered about in several districts of Italy, and little known except to those who have made a special study of Italian art.

Mr. A. Moresby White dealt with the "Improvement of Our Roads," mainly from the cyclist's point of view, and described the action which has lately been undertaken by a department of the Cyclists' Touring Club for bringing public attention to bear on the matter, so that cyclists, and, indeed, all who use the roads, may have less to complain of than they have at the present time.

Professor W. M. Flinders Petrie's paper on "A National Repository for Science and Art," brought before the Society the proposal which Professor Petrie has already submitted to the British Association, that steps should be taken to construct in some convenient locality, accessible from London, but where land is moderately cheap, a great storehouse or repository where articles too bulky or too numerous for the limited space in our present museums, might be stored in such a way as to be available for examination by students.

II.—Indian Section.

The session of this Section has been in all respects a successful one, and its six meetings have attracted considerable attention, not only in this country, but in India.

In a remarkable and brilliant paper on "Our Work in India in the 19th Century," Sir William Lee-Warner passed under review the more important victories of peace and war won by us in our great Asiatic Empire since the year 1800, calling attention to and illustrating the effects of the removal of European rivals from our path in India; the establishment of British sovereignty over the Native States—States "which have grown with the British dominion and strengthened with its strength;" the wonderful revolution caused by rapid oceanic and internal communications; the institution of the *Pax Britannica*; the reform of the public service, and the abolition of barbarous customs. The reader concluded with some weighty observations designed to direct the thoughts of the audience to the question of the popularity and prospects of a rule "founded upon the three foundations of good faith, material development of the country, and impartial justice."

The need for a more extended development of the industrial resources of India—a need that has on more than one occasion recently been insisted upon by the present Viceroy—was ably dealt with by Mr. J. A. Baines, who, in the course of his paper, mentioned that, above the grade of earthen and copper wares, nearly every article manufactured in India is of foreign origin. Although the requirements of India, as essentially a peasant Empire, must not be lost sight of, Mr. Baines urges that every possible effort should be made to diminish the present numerical disparity between the relatively small artisan class and the enormous agricultural population. Indian society being, however, what it is, the industrial development of the country will, he thinks, be slow, and therefore more in harmony with the inclinations and genius of the people, thereby being established on a wider base than could be devised for it by foreign endeavour. A practical and useful discussion of the paper was wound up by an important speech from the Secretary of State for India, Lord George Hamilton, who presided on the occasion.

"The Cultivation, Manufacture, and Uses of Indigo" was the title of an exhaustive paper contributed by Mr. Christopher Rawson, who hopes that by the introduction of improved methods of production, the cost of "the most valuable and important of all colouring matters" may be cheapened, and the threatened replacement of natural indigo by the synthetic dye averted. The importance of the industry to India, is shown by the facts mentioned, namely, that in the province of Behar, 700 Europeans are employed on the indigo plantations, and that the amount of capital invested in those estates amounts to £4,000,000.

In a suggestive paper on "New Projects of Railway Communication with India," written more with the object of familiarising the public with the idea of linking the Russian and Indian railway systems, than of supporting any particular project, Mr. J. M. Maclean, M.P., advocated a line, viâ Orenburg, the advantage claimed for that scheme being that it would afford a continuous land route from Calais to Calcutta. In the discussion, preference was expressed by Sir Thomas Holdich and other authorities for the Herat and Quetta route. But it was pointed out that perhaps the most serious of all the obstacles is the inexorable

ostility of the Ameer Abdurrahman to the ntroduction of railways into Afghanistan.

Colonel Richard Carnac Temple supplemented the paper he read in the Session of 899 on the Indian penal system, by a vivid nd instructive description of the interesting erritories comprised within the jurisdiction of he Chief Commissionership of the Andaman nd Nicobar Islands. He, at the same time, dvocated the establishment, by means of the Marconi system, of telegraphic communication etween India and the Andamans.

An excellent paper by Sir John Scott on "English and Anglo-Indian Criminal Proedure," concluded the Session. He urged) that the Indian penal code, though an nportation, has given great satisfaction to the ndian people, (2) that although some parts of e Indian code are not suitable to the needs f England, much in it is better than what is to e found in our own system, and (3) that a ode is much better for any people than an unodified body of law. Attention was called to e fact, so often overlooked, that the judiciary f India is largely and increasingly composed f Indians.

III.—Foreign and Colonial Section.

The papers, four in number, read before is Section included a valuable contribution y Sir Charles Dilke, on "The Century our Colonies." British self-government in e great colonies is not, he pointed out, an vention, as is now often thought, of our own mes, of the second half of the century, or ven of the Queen's reign, but was born ng previously in the West Indies and e American colonies, and survives in anada. Although the foundations of the ritish Empire, as we know it now, were id in the days of Elizabeth and by Cromwell, e actual result in territory at the beginning f the century had been small. The most teresting considerations of the speculative pe which are now connected with the British mpire turn, he observed, upon the future in e Pacific. This future, in the first instance, es in the relations of our colonies and of the nited States with Germany and Japan, and, the long run, in the relations of our colonies d the United States with Russia. The conderation of Australia in the Commonwealth ill, he holds, rapidly advance her action in the acific. Sir Charles Dilke's paper was folwed by an exceptionally valuable discussion which the Chairman (Lord Strathcona and ount Royal), the Hon. J. I. Tarte, the Hon. Alfred Deakin, and other distinguished colonists took part.

In a timely paper, on "Imperial Telegraphic Communication," Sir Edward Sassoon, M.P., maintained that a reduction of all unnecessary charges incident to the modern development of commercial methods has become a vital necessity; and cable charges, he proceeded to say, enter very largely into the laying down costs of commodities. He not only advocated an immediate reduction of rates, but expressed his firm belief that the ultimate possession of the cables by the State is only a question of time. Meanwhile future agreements should provide for a definite scale of charges based on probable or ascertained gross earnings, while prohibiting any extensions or amalgamations that would conflict with or diverge from the proposed all-British system. The views of the reader of the paper were supported by the Chairman of the meeting, Sir Henry Fowler, M.P., as well as by Sir Patrick Playfair and others, while the Hon. George Peel vigorously defended the cable companies.

Mr. John Ferguson, in a most interesting paper on "Old and New Colombo," briefly sketched the foundation of that prosperous port and its history under the Sinhalese, the Portuguese, and the Dutch, afterwards treating in more detail its rise, under its present rulers, the British, to be the commercial and political capital of the island. He said that the day is approaching when Ceylon should rival Egypt as a place of winter resort, and he made an earnest appeal to the British Association to hold its annual meeting at Colombo in 1903 or 1904.

The fourth paper was contributed by Mr. R. Hedger Wallace, who presented a large amount of useful information collected by him, principally from official sources, showing what is being done throughout "Greater Britain" in respect to agricultural education.

IV.—Applied Art Section.

At the first meeting of this Section, on January 30th, Mr. Cyril Davenport read a paper on "Niello Work," in which he traced the history of this elegant art from Roman times, and pointed out how strongly marked were the characteristics of the various periods into which he divided his subject. The use of Niello by Roman, Saxon, and Celtic artists was described, as well as the remarkable revival of it by Finiguerra in the 15th century, a revival which connects this art with that of the most delicate form of engraving prevailing in

Italy at the same time. The paper was illustrated by a fine series of lantern slides showing specimens of the art from the first centuries to the 19th.

The second paper was by Mr. Lasenby Liberty on "English Furniture." In it, after presenting the chief historical facts relating to furniture, he made valuable suggestions as to the true principles that should govern furniture construction. In his opinion, the latter half of the 16th century covered the finest period of taste in domestic furniture, and specimens of that period to be found in such Elizabethan mansions as Holland-house, Knole, &c., might form models for a future national style.

On April 3rd, Mr. Carl Hentschel read a comprehensive paper on "Process Engraving," an art which has come into general use within the last twenty or thirty years. Early attempts in this direction were made before the invention of photography, but it is the progress of photography that has enabled "process engraving" practically to kill wood engraving. The paper was illustrated by a series of slides showing how process blocks were manufactured.

Mr. Nelson Dawson, on May 8th, dealt with "Art Metal Work," sketching the history of the subject from the Greek period, and showing how, in spite of the work of later times, the purity of Greek art had never been equalled. The fine series of lantern slides shown by Mr. Nelson Dawson contained, among other examples, illustrations of forged iron work on church doors, and of wrought iron gates and railings in various parts of London.

The last meeting, on May 22nd, was occupied by an instructive paper by Mr. Edward F. Strange, on "The Practice of Lettering." The author enlarged on the artistic use of the Roman alphabet, pointing out how effective were such fine inscriptions as that on the Trajan Column, and the advantages the Roman has over the Gothic alphabet for purposes of mural decoration. He showed that artists had not to re-invent the letters, but to use them with a proper regard to proportion. Artists should make the best use of the Roman alphabet, and should show the beauty of well-formed letters.

The meeting in February was abandoned, in consequence of the illness of Mr. John Sparkes, whose paper on "The Best Means of Arresting the Decay of Indian Art" had to be postponed. Unfortunately, Mr. Sparkes did not recover sufficiently to read his paper at a later part of the session.

V.—Cantor Lectures.

The first course of Cantor Lectures was by Mr. H. H. Cunynghame on "Art Enamelling upon Metals." For some time past Mr. Cunynghame has devoted himself, as an amateur, to the preparation of enamels, he has studied the whole subject with the utmost thoroughness, and has achieved remarkable success both in the preparation of the materials, and in the making of the finished enamels. In his course of lectures, he not only gave a brief account of the history of the various styles of enamelling, and a full description of the various methods, but he also gave full practical demonstrations of the whole process, including the preparation of the metal plate, the treatment of the glasses of which the enamels consist, and the execution and firing of a completed enamel. He showed that the work is quite capable of being carried out by anyone endowed with sufficient manipulative skill and artistic capacity, and it is to be hoped this admirable course of lectures may have had the effect of inducing fresh attention to a very beautiful, but, in practice, somewhat neglected art.

In the second course of lectures which was delivered after Christmas, Mr. Bennett H. Brough, the Secretary of the Iron and Steel Institute, dealt with the "Nature and Yield of Metalliferous Deposits." Mr. Brough's object was to provide some popular information on mines and mining for the benefit of the somewhat numerous class who invest in mines, but who may be supposed to be desirous of obtaining a little more information about their property than, as a rule, they certainly possess. Mr. Brough's first lecture was of a general character, dealing with ore deposits and ordinary methods of mining. His second lecture was devoted to gold and silver, his third to iron, and his fourth and concluding lecture to copper, lead, and other metals.

The third course was by Mr. E. Sanger Shepherd, on "The Photography of Colour." Mr. Shepherd has for some time past been working at the three-colour process on the lines of Mr. Ives, and by improvements in the colours used, both for the screens employed in taking the original photographs and in those employed in the finished pictures, he has certainly advanced the process to a point which it had not previously reached. After a general introduction, to which his first lecture was devoted, Mr. Shepherd treated in his second lecture on the representation of colour in monochrome. In his third, he considered

he representation of a coloured object in its natural colours; while the last lecture was devoted to the application of the trichromatic method of colour photography in the printing-press. Mr. Shepherd's lectures were very fully illustrated throughout, and amongst his illustrations he showed some very beautiful coloured lantern slides, produced from brilliantly-coloured natural objects, such as flowers, fruit, butterflies, &c.

The fourth course of Cantor Lectures was to have been delivered by Major Cardew, and the subject, "The Control, Regulation, and Measurement of the Supply of Electrical Energy." Unfortunately Major Cardew was obliged to pay a visit to Australia, and this compelled him to abandon the idea of lecturing. Prof. Fleming undertook to supply his place with a course on "Electric Oscillations and Electric Waves," but by a very unfortunate coincidence he also was summoned away, and had to go to America. Prof. Vivian Lewes kindly undertook, at somewhat short notice, to fill the gap with a course of lectures on "The Incandescent Gas Mantle and its Use." The members of the Society are much indebted to Professor Lewes for many interesting and instructive courses, including several on gas-lighting. In his last course he gave a history of the incandescent mantle, and of the gas-burners employed in its use.

VI.—Juvenile Lectures.

The Juvenile Lectures for the present session were given by Mr. Herbert Jackson, the subject being "The Phenomena of Phosphorescence." The two lectures of which which the course consisted were illustrated with a splendid series of experiments, some of which had originally been prepared for Mr. Jackson's very successful lecture before the British Association a year previously, while others had been specially prepared for the Juvenile Lectures. Few finer lecture experiments can have been shown than the beautiful series of phosphorescent objects specially prepared by Mr. Jackson, which, when excited by a powerful discharge from an induction coil, glowed with various tints representing the various parts of the spectrum. The phenomena of phosphoresence in exhausted tubes specially lend themselves to attractive experimental demonstration, and they also were copiously illustrated.

VII.—Albert Medal.

The Albert Medal for the present year has been awarded, with the approval of His Royal Highness, the President of the Society, to Mr. Henry Wilde, F.R.S,, "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and for its application to the production of the electric search light and to the electro-deposition of metals from their solutions." It was in a paper read before the Royal Society in 1866 that Mr. Wilde enunciated the proposition that quantities of magnetism and electricity indefinitely small will induce quantities of those forces indefinitely great. The proposition was demonstrated by experiments on a large scale, in which a powerful electric light was evolved for the first time from a dynamo machine. Later on it was shown by the brothers Siemens and others that even the small amount of magnetism required in Mr. Wilde's machine could be dispensed with, the residual, or permanent, magnetism of iron being sufficient to afford the necessary starting point.

This principle of Mr. Wilde's is the one on which the modern dynamo is constructed, and although the originality of his discovery has never been questioned, while its importance is well known to electricians and all who have studied the subject, the merit of his invention is not perhaps sufficiently familiar to the general public. In addition to this important discovery Mr. Wilde has produced other valuable inventions. His dynamos were first used for the production of the search light in the Royal Navy, and they were also largely employed for the electro-deposition of metals from their solutions.

VIII.—Medals.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1899-1900.

At the Ordinary Meetings:—

To D. E. Hutchins, Conservator of Forests Cape Town, for his paper on "National Forestry."

To Sir W. Martin Conway, M.A., for his paper on "Some of the Undeveloped Resources of Bolivia."

To Edmund Wilson, for his paper on "The Housing of the Poor."

To Professor R. W. Wood, for his paper on "The Diffraction Process of Colour Photography."

To Edwin Bale, R.I., for his paper on "Artistic Copyright."

To Miss Halsey, for her paper on "Some Unfamiliar Masterpieces of the Italian School."

To Professor W. M. FLINDERS PETRIE, D.C.L., for his paper on "A National Repository of Science and Art."

To A. R. COLQUHOUN, for his paper on "Russia, Persia, and Afghanistan."

In the Indian Section :—

To Sir WILLIAM LEE-WARNER, K.C.S.I., M.A., for his paper on "Our Work in India in the 19th Century."

To CHRISTOPHER RAWSON, F.I.C., for his paper on "The Cultivation, Manufacture, and Use of Indigo."

In the Foreign and Colonial Section :—

To JOHN FERGUSON, for his paper on "Old and New Colombo."

To the Right Hon. Sir CHARLES WENTWORTH DILKE, Bart., M.P., for his paper on "The Century in Our Colonies."

In the Applied Art Section :—

To CYRIL DAVENPORT, for his paper on "Niello Work."

To LASENBY LIBERTY, for his paper on "English Furniture."

IX.—OWEN JONES PRIZES.

These prizes have now been awarded annually since the year 1878. Owen Jones died in 1874. After his death a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Science and Art Department.

The prizes were awarded this Session, each prize consisting, in accordance with the regulations laid down for the administration of the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal. The names of the successful candidates appeared in the *Journal*.*

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

* See *Journal*, vol. xlvii., p. 755, August 18, 1899.

X.—PRIZES FOR DRAWING.

Since 1889, the Council have placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and as usual, these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last.

XI.—EXAMINATIONS.

The Council propose to make some rather important extensions of the examination system of the Society. For some time past the demand has been put forward for an elementary or preliminary grade, the standard of the present examinations being somewhat high for the large class of pupils who are now being educated in continuation-schools. A great number of candidates from these schools are now entering for the Society's examinations, and probably they furnish a considerable proportion of those who take third-class certificates. The experiment tried three years ago, of adding an elementary stage to some of the language subjects, has proved sufficiently successful to justify the idea that the provision of an elementary grade would be welcomed by a very large number of students of the class mentioned.

The continued and growing success of the present system of examinations seems to indicate that but little alteration in them is required, and the Council have come to the conclusion that the requirements of the case might best be met by establishing a system, of which the present series might form the general or intermediate grade, and that this might be supplemented by a preliminary grade, with a lower standard, and completed by the addition of a senior grade, of a standard considerably higher than that of the present examination. It has also seemed to the Council that the existing system would be made more complete if a general certificate were given in each grade, which might afford evidence of a candidate having qualified in the various departments of a sound commercial education. While there is undoubtedly a demand for certificates in separate subjects, there is also a demand, especially among men of business, for some certificate which shall afford a reasonable testimony of the qualifications of applicants for employment in commercial houses.

Twenty-four years ago the experiment was tried of awarding certificates in commercial knowledge to candidates who had passed in a

pecified number of subjects. At the time the xperiment was not considered successful, and t was abandoned, the old system of certificates n separate subjects being resumed. But the onditions are now somewhat altered. There s a much greater demand for commercial eduation than there was twenty-four years ago; nd the Council believe that the experiment vas founded on sound principles, and will prove more successful now than when it vas first tried. They therefore propose to ward, in addition to the certificate granted or each separate subject, a certificate of proiciency in commercial knowledge in each grade to any candidate who has passed in ertain specified subjects within a period of hree years.

The subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certiicate, and passing in additional subjects within the stated period, can have these dditional subjects endorsed on their certifiate.

As regards the examinations of 1900, the Council do not propose to hold an examinaion next year in the senior grade. A syllaus for such an examination will be carefully onsidered, and will probably be issued next ear, with a view to the examinations in the ear following. Nor is it proposed to make ny alteration of importance with regard to he existing system, except that the elementary papers for modern languages will not be set, nd, as above stated, a certificate of proficiency vill be issued to any candidate who has passed n five specified subjects within a period of hree years. The subjects specified are :—(1) Arithmetic, (2) Book-keeping, (3) Précis-writng, (4) Shorthand, (5) A modern language. Candidates who have qualified in these five ubjects during the period covered by the xaminations held in 1898, 1899, and 1900, vill be entitled to claim such certificates. Application for them will have to be made hrough the usual channels, and a form for he purpose will be issued to the secretaries f examination centres.

A syllabus for the preliminary or junior grade has been drawn up, and copies can e had on application at the office of the Society. The subjects of examination are :— Handwriting and Correspondence, Shorthand, Elementary Book-keeping and Office Routine, Commercial Arithmetic, Comercial History nd Geography, Preliminary French, Preminary German, Elements of Type-writing. The first four are compulsory, the last four optional.

The first examination in this preliminary grade will be held in March, 1901, the precise date will be hereafter announced.

The Council are much indebted to Mr. H. Macan, the Organising Secretary of the Surrey County Council, for the advice and assistance he has rendered in the preparation of the scheme, especially by drafting the syllabus for the examination in the preliminary grade.

The number of candidates who entered for the examinations this year still shows an increase, the number being 8,894, or 124 more than the corresponding number last year, 8,750. It will be noted that the rate of increase is much less than of recent years, the figures for which are given in the accompanying Table :—

Year.	No. of Candidates.	No. of Papers worked.	No. of Centres.	No of Subjects.
1890........	2,315	2,474	79	14
1891........	2,460	2,667	78	14
1892........	*2,928	3,143	96	13
1893........	3,702	3,916	109	13
1894........	4,106	4,376	131	14
1895........	4,777	5,108	146	14
1896........	6,111	6,568	197	16
1897........	6,919	7,513	221	19
1898........	7,636	8,372	243	19
1899........	8,750	9,581	260	23
1900........	8,894	9,808	267	23

* Total, with supplementary autumn examination, 3,351.

The results of this year's examinations will be issued in the course of a few days. There seems reason to believe that the improvement in the quality of the candidates noted last year is still proceeding. It is true that the per-centage of first-class certificates (7·05) is less than last year, when it was 8·3, though better than in 1898, when it was 6·05; the per-centage of second-class (20·3) is also less than last year, when it was 21·0; but there is a considerable increase among those who obtained a third-class, and a considerable decrease among the failures. This year the third-class candidates show a per-centage of 33·5 as compared with a per-centage of 29·56 last year; and the failures are 29·6 compared with 32·7.

The number of papers worked this year was 9,808, the number last year was 9,581. This

small increase is distributed generally over the different subjects, the numbers in each corresponding very closely with the numbers last year. There is an increase of 37 candidates in Arithmetic—319 against 282. In English there is a slight falling off of 24—230 as compared with 254. Book-keeping is the only subject which shows a considerable diminution, there being 322 candidates less this year than than there were last year—3,684 as compared with 4,006. These candidates, however, may be considered as nearly all of the lowest class, as the proportion of failures is very much less in this subject this year than last. In Commercial Geography the numbers are practically the same—116 this year, 118 last year. In Shorthand there is a slight increase of 80, the numbers being 2,293 against 2,213. Typewriting shows an increase of 211—673 against 462. This is the largest proportionate increase in any subject. In Economics there are 5 less —29 this year and 34 last. In Précis-writing there is a proportionately large increase of 38, as there are 66 compared with 28 last year. In French there is a trifling increase—403 against 398; but in Elementary French there is a more than corresponding diminution — 371 against 395. In both stages of German there is an increase—289 and 204 against 263 and 184. Spanish is practically the same—108 and 107; and in the elementary stage, 59 and 58. There are 33 candidates in Portuguese, last year there were 39; 7 in Russian, the same number as last year; and while there were 5 in Danish last year, this year there are only 3. Domestic Economy shows an increase of 21—243 against 202; and both the music subjects are larger than last year—Rudiments of Music 454 compared with 341, and Harmony 197 compared with 167, an increase of 43 in all.

XII.—Practical Examinations in Music, 1899.

The Practical Examinations in Music for 1899 were not concluded last year until the 12th July, too late for the results to be included in the Report of the Council. They were, however, published in the *Journal*.* The examinations lasted for 13 days.

The system of examination was the same as that for the previous year. For instrumental music certain standards (four in number) are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music, and for each standard a list of music is given for study, and for the pianoforte examination a selection from this list is sent to the candidates six weeks previous to the examination. For other instruments the pieces can be at once chosen from the general list. Candidates are then expected to play or sing the pieces which they have prepared, and in the third and fourth standards to play a piece, or a portion of a piece at sight, in addition.

In all 529 candidates were examined, a decrease of 9 as compared with the previous year; 3 of these took up two subjects, so that there were 532 examinations. Of these there were 508 passes and 24 failures.

The following were the subjects taken up:—Piano, singing, violin, viola, violoncello, mandolin, and organ. 419 entered for the piano, 399 of whom passed and 1 obtained a medal; 66 entered for the violin, of whom 56 passed and 5 obtained medals; 2 entered for the violoncello and passed; 1 passed for the mandolin; 5 entered and passed for the organ; 38 entered for singing, and all passed, 5 obtaining medals; 1 entered for the viola and passed.

Mr. John Farmer, of Balliol College, Oxford, and Director of the Harrow Music School, acted as Examiner, Mr. Ernest Walker, M.A., Mus. Doc. Oxon., and Mr. Burnham Horner, as Assistant-Examiners.

XIII.—Practical Examinations in Music, 1900.

The Practical Examinations for the present year have not yet been concluded. They only commenced on Monday, 25th June, and will be finished on or about the 9th July, after which a summary of the results will be given in the *Journal*. In consequence of Mr. Farmer's ill-health, the work of the examining has had to be undertaken by the two assistant examiners, Dr. Walker and Mr. Horner.

These examinations were proposed in 1876 by Dr. Hullah, and were first established in 1879. Dr. Hullah acted as examiner from 1879 till his death in 1884. He was succeeded by Mr. W. A. Barrett, who had for some time previously acted as his assistant in these examinations as well as in his official work. Mr. Barrett carried the work on till 1891, when he died. Sir John Stainer was appointed examiner in 1892 conjointly with Mr. W. McNaught, but after serving for one year he was succeeded by Sir Joseph Barnby, who

* See *Journal*, vol. xlvii., p. 731, August 4, 1899.

eld the post till 1894 in conjunction with Mr. McNaught. In 1895 Mr. John Farmer was ppointed, and he has since continued to act.

In the first year of these examinations—1879 —117 candidates were examined. This number ncreased gradually and intermittently to 276 n 1891, and to 395 in 1895. In 1896 the ystem described in the preceding paragraph f this report was introduced. No alterations ave since been made in this system. In 1896 here were 376 candidates, in 1897 there were 92, in 1898, 539, in 1899, 529, and for the resent year 558 have entered.

XIV.—Society's Medal.

It was found that a slight flaw had developed self in the die which has been used for triking the Society's medals since the year 863, when H.R.H. the Prince of Wales ecame President of this Society. As the nembers are aware, the Society's medal bears n one side the head of its President. It was matter for the consideration of the Council whether the original die should be reproduced, r whether a fresh one, with a new portrait of His Royal Highness, should be used; and on ubmitting the matter to the President for his ecision, His Royal Highness expressed a wish hat a new head should be prepared giving a keness of himself at the present date. He lso desired that the execution of the new die hould be entrusted to Mr. Emil Fuchs, who ad already prepared a medallion portrait of His Royal Highness. In accordance with he Prince of Wales's wishes, the commission was given to Mr. Fuchs for the preparation of fresh die, and that gentleman has now prepared an admirable likeness of the Prince, which will in future be used on the Society's nedals.

XV.—Memorial Tablets.

A suggestion was submitted to the Council hat one of the Society's memorial tablets should e erected on the house, 54, Hunter-street, Brunswick-square, W.C., in which John Ruskin was born. The necessary permission aving been obtained from the ground landords (the Board of the Foundling Hospital) nd the lessees, the Council have given nstructions for the preparation and erection of tablet in commemoration of this fact.

XVI.—Leather for Bookbinding.

For some time past librarians, bookbinders, nd others interested in the care of books, have een greatly exercised in mind at the way in which modern leather when used for bookbinding seems to perish. It appears certain that a good deal of the leather now in use has been injured in the process of manufacture and dyeing, and is not likely to last for a reasonable time. After a good deal of informal discussion on the subject, a number of these gentlemen, amongst whom Mr. Douglas Cockerell was a moving spirit, asked the Council of the Society of Arts if they would appoint a committee to conduct a thorough inquiry into the whole question of Leather for Bookbinding, and eventually to issue such a Report as was published at the close of the inquiry into the question of the Deterioration of Paper.

The Council, after giving due consideration to the subject, readily acceded to the request, and nominated a Committee, and they hope that, as the result of its investigations, a useful, practical Report may be issued. The Committee includes amongst its members librarians, owners of libraries, bookbinders and manufacturers of leather. They have already met, and have taken the subject up in a thoroughly practical manner. A Sub-Committee of its members have undertaken to visit libraries, and collect evidence as to the perishing of modern leather, as compared with that formerly used; and another Sub-Committee have undertaken to report on the manufacture of leather, to investigate the causes of its decay, and, if possible, to suggest remedies. Lord Cobham was elected Chairman at the first meeting.

XVII.—Literary Copyright Bill (H.L. 1900).

The attention of the Council has been drawn to the fact that the Copyright Bill now before the House of Lords is likely to affect the rights of this and other societies in respect of the copyright of their publications. This Bill makes provision for the case of individual and joint authors, and also for the case of what is termed "Collective work," in which a proprietor pays contributors for their contributions; but it seems to ignore the case of publications by societies, in which case, as a rule, no payment is made to the contributors. Apparently no provision is made for securing the copyright of scientific transactions or journals, and it is to be assumed that the copyright in that case would vest in the author. If this is so a Society would not be able, without obtaining the consent of all the contributors, to reprint in whole or in part any number of its

proceedings which might have gone out of print, nor would it be possible, without the express consent of the contributors, to authorise the publication in newspapers or magazines of papers read before it, or printed in its transactions.

It might presumably be possible to bring the proceedings of a Society under clause 10 of the Bill (which deals with "Collective work") by making a nominal payment to all contributors, but even in that case the Society would not be enabled to authorise republication, without the express consent of the original author, who is empowered on his own account to institute proceedings for infringement of copyright, and who has, after two years, a copyright in his contribution.

Under Clauses 3 and 4 of the Bill, also, scientific and other societies would be precluded, without the express consent of the original author, from making and publishing abstracts of scientific papers. In many of the great technical societies this will be a very serious grievance, as an important part of their transactions consists of abstracts of proceedings of foreign societies, and journals relating to subjects kindred to their own businesses; thus the Institution of Civil Engineers publishes abstracts of foreign (and sometimes of British) communications relating to engineering, the Institution of Electrical Engineers publishes abstracts of British and foreign papers relating to electricity, and so on. The Society of Arts does not do this as a regular thing, but it has happened not infrequently that it has published appendixes to the reports of its committees consisting of such matter. The latest instance is the report of the Committee on Paper. This report had a long appendix, composed entirely of abstracts of foreign papers dealing with the manufacture, examination, and analysis of printing papers. It would be practically impossible to obtain the consent of the author in each individual case, and if the Bill passes into law in its present form, it would interfere with a very useful and valuable class of publications now much valued by scientific men and by technical workers.

The Council has appointed a small committee to consider the matter, and one of its members has also undertaken to give attention to the matter in the House of Lords.

XVIII.—Exhibition of Modern Illustration.

For some time back the Society of Illustrators had had in contemplation the holding of an Exhibition of examples of Modern Illustration. It appeared, however, that such an exhibition could not well be held in London without resulting in considerable financial loss and the Society of Illustrators therefore did not proceed with the proposal. Some members of that society, however, brought the matter before the Society of Arts, and a Committee appointed by the Council to consider and report on the subject confirmed the conclusion which had been arrived at by the Society of Illustrators. The Society of Arts was not in a position to find the funds that would be required for the hire of a suitable gallery, and for other expenses, but it was suggested that the Science and Art Department (now the Board of Education) might be asked if they would not take similar action to that taken with regard to the Exhibition of Lithography in 1898, and arrange for an exhibition in the galleries available at the Victoria and Albert Museum. In response to an application by the Council, the Board of Education consented to undertake the organisation of the proposed exhibition, on the understanding that the Society of Arts would furnish the manuscript for the catalogue, a condition to which the Council assented. The members of the Society's Committee, with certain additions, were asked to form an Advisory Committee by the Department, and arrangements are now in progress for the holding of the exhibition. It is proposed it shall be opened about the 15th of November next, and remain open about three months.

It is to comprise typographical reproductions, and their drawings, which have been executed since 1860; that date being selected because it would cover the period within which photography has been available for reproductive purposes, and during which consequently the original drawings have been preserved, and are available for exhibition.

It is hoped that this exhibition will provide a very complete exemplification of the progress of book illustration, and of the British school of drawing for it. The exhibition will also include a selection from the work of some foreign artists. It will consist for the most part of prints, accompanied by original drawings for the same, but it is also proposed to show wood and "process" blocks. The exhibition will be held in the galleries at South Kensington on the west side of the Exhibition-road.

XIX.—Chadwick Trust.

It was mentioned in the last report of the ;ouncil that the late Sir Edwin Chadwick, who lied in 1890, left a considerable sum of money o establish a Trust for the purpose of awarding ›rizes, establishing lectures, and taking other ;teps for the promotion of sanitary science. [he Society of Arts was one of the bodies vhich were requested to nominate trustees, ind on the formation of the Trust Sir Douglas ;alton was appointed, in 1896, the representa- ive of the Society. On his death last year the ;ouncil appointed Mr. R. Brudenell Carter a nember of the Trust.

Mr. Brudenell Carter has prepared a report n the work of the Trust which has been pre- ented to the Council, and will shortly appear n the *Journal*.

XX.—Conversazione.

The annual Conversazione of the Society vas held this year, as last year and the year efore, at the Natural History Museum, by ermission of the Trustees of the British Auseum.

The arrangements were the same as in revious years. Special arrangements had) be made for lighting the Museum. As he building is not intended to be opened ı the evening, it is not sufficiently lighted ›r the purposes of a Conversazione. For his reason only a small portion of the build- ıg is available. On the present occasion ıe only parts of the Museum used were the ;entral Hall, with its surrounding corridors ıd galleries, and the Mammalia Gallery, 'hich occupies a portion of the ground floor f the eastern wing of the Museum. The lird Gallery, which was used on previous ccasions, is not now available. These gal- ›ries were specially lighted with the electric ght, the expense of the installation being ıared with the Royal Geographical Society, ıe Royal Colonial Institute, and the In- ;itution of Electrical Engineers—all of which ocieties held Conversazioni in the building bout the same date.

The usual arrangements for music and ›freshments were made. Tickets were issued s on previous occasions to the members of the ociety, and additional tickets were sold to ıembers. The Metropolitan District Railway ompany were good enough to allow visitors ho used the underground railway the free use ' their subway leading from the South Ken- ngton railway station into the grounds of the Museum. The total number of visitors at- tending the conversazione was 1,371.

As on previous occasions, the Council have to thank the principal officers of the Museum for their help in carrying out the arrange- ments for the evening.

XXI.—New Council.

The following Vice-Presidents, five in number, retire this year:—Sir William Abney, Sir George Birdwood, Sir Frederick Bramwell, Viscount Cross, and Sir John Donnelly. In their place, the Council have nominated for election the following:—The Master of the Rolls (Lord Alverstone), Mr. Michael Carteighe, Sir Ben- jamin Baker, the Hon. R. C. Parsons, and Mr. H. Graham Harris. Lord Alverstone has just completed a year's service as Treasurer of the Society, and Mr. Harris has been for the past four years an Ordinary Member of the Council. The other three have not served during the past year, but both Sir Benjamin Baker and Mr. Carteighe have held office in previous years.

The four retiring Members of the Council are:—Professor James Dewar, Mr J. G. Gordon, Mr. H. Graham Harris, and Sir Edward Montague Nelson. To supply their places, the Council propose:—Sir William Lee-Warner, Sir William Chandler Roberts-Austen, Mr. Alexander Siemens, and Mr. John I. Thorny- croft. Sir William Roberts-Austen and Mr. Alexander Siemens have held office in previous years, but neither Sir William Lee-Warner nor Mr. Thornycroft have previously served on the Council.

The Council propose the name of Sir Frederick Bramwell as Treasurer, to take the place vacated by the Master of the Rolls.

XXII.—Obituary.

Although the list of obituary notices which have appeared in the *Journal* during the past year is rather a long one, it does not include so many names actively associated with the work of the Society as in recent years. Among those who took a more active share in the Society's work by serving on its Council may be mentioned Sir James Paget, the celebrated surgeon, Sir Edward Frankland, the eminent chemist, Sir Frederick Nicolson, for long chairman of the Thames Conservancy, Mr. Charles Barry, the well-known architect, and Mr. Henry Vaughan, the distinguished art collector.

Two members who had received the dis- tinction of the Albert Medal, and both of them

in recent years, died within a short period of one another; Professor David Hughes, the eminent electrician, and Mr. George J. Symons, the well-known meteorologist. Professor Bunsen, to whom the Albert Medal had been awarded in 1898, also died last year.

Sir George Grove was not a member of the Society, but he was associated with it as its Secretary from 1850 to 1852. Sir Arthur Cotton read several papers on Indian subjects, and was a constant contributor to the *Journal* of letters on the subject of irrigation. Admiral Colomb read two papers on naval subjects before the Society. Mr. Rogers Field took a leading part in the Society's Sanitary Conferences, and contributed to their proceedings. General Pitt-Rivers read a paper before the Society on his well-known museum. Among other eminent members of the Society who passed away during the last year, but who took a less active share in its work, may be mentioned Lord Farrer, Sir Henry Tate, Major-General Hutchinson, Mr. Ismay (one of the founders of the "White Star" line), and Mr. John Donaldson, the well-known engineer.

Obituary notices of all the above, and of several other members who have passed away during the year, have appeared in the *Journal* of the Society.

XXIII.—List of Members.

The number of Life and Subscribing Members now on the Society's books is 3,082. There are 41 Honorary Corresponding Members. The number of Institutions in Union is 28.

During the Session 255 new members were elected, and the Society lost 182 by death or resignation.

XXIV.—Finance.

The Annual Statement of Receipts and Expenditure was published, in accordance with the Bye-laws, in the *Journal* last week. It shows the revenue of the Society for the financial year ending May 31st last, and the Society's liabilities and assets, its investments, and the Trusts standing in its name. It does not show any material alteration in the financial position of the Society, and while comparing favourably with those of recent years, corresponds very closely with them in its details.

[Sir John Wolfe Barry having been obliged to vacate the chair during the reading of the report, Major-General Sir Owen Tudor Burne presided over the remainder of the proceedings.]

The Chairman (Sir Owen Tudor Burne) move the adoption of the report, and said he should like t remind the members how much they were indebte to Sir John Wolfe Barry for his addresses on th Communications of London, which were very im portant papers, showing how two great streams traffic, crossing one another, can be carried o without interruption. He thought the other pape read during the session had been good, an quite up to the standard. As he said last yea the Society's papers and lectures were circulate by means of the *Journal* throughout the worl and this fact alone attracted many members t the Society. He thought they would agree with hi that the position of the Society was extremely sati factory, as notwithstanding the heavy losses throug death, there was a net increase of 73 in its membe ship. They would notice the changes of considerabl importance which were to be made in the examination also that during the past ten years the number o candidates examined had increased by nearly 7,00 In former years the Society had done a great deal o good and useful work through its Committees o different subjects, and, as would be seen by th report, this work was still continued. He expecte that the Committee on the preparation of Leather fo Bookbinding would produce a very valuable report.

Mr. Francis Cobb seconded the adoption of th report, and said they would agree with the Chairma that the financial state of the Society was highl satisfactory.

Surgeon Lieut.-Colonel John Ince said that th report was so good that it left little room for remark to be made. The financial position of the Societ appeared to him to be very satisfactory indeed, but h thought it was a pity the Society was not stronger in th number of its members, especially as the work of th Society was so extensive in its objects. The Counci was composed of men who represented the cream o the various arts and industries of the country, and i would be well if members could use their influence t induce the proprietors and managers of the larg manufacturing establishments throughout the country and throughout the empire, to interest themselves in the Society. The work of the Society's Committee was very important, and he was glad to see that th subject of leather was to be inquired into. The subjec was to engage the attention of competent men—men who understood all the various chemical processes— and he hoped they would be successful in their work. He congratulated the members upon the satisfactory position of the Society, and said they were very much indebted to the Council and to the Society's officers or their services.

Sir George Birdwood, K.C.I.E., C.S.I., agreed that an effort should be made to secure the support of the managers of manufacturing establishments. In a few years' time the present lease of the Society's

house would expire, and if the lease could not be renewed it would require an enormous sum of money to provide a new building. This money could only be raised by means of a largely increased membership. He did not know whether it might not be well to institute small annual exhibitions of various industries, such as jewellery, textiles, &c. This would popularise the Society, and impress upon manufacturers the importance of the Society to themselves. The manufacturers of this country seemed to lack in knowledge and intelligence, and unless some steps were taken we should be beaten out of the markets of the world.

The adoption of the report was then agreed to.

The CHAIRMAN moved a vote of thanks to Sir Henry Trueman Wood, also to Mr. Wheatley, Mr. Room, Mr. Davenport, and the other officers of the Society for the loyal and efficient work which they did year after year.

Mr. W. MARTIN WOOD, in seconding the vote of thanks, said he coincided with the Chairman's remarks. With regard to the remarks of Dr. Ince as to the small number of members of the Society and the need for their increase, he thought if the Annual Meeting could be held in the evening instead of the afternoon, it would be attended by a greater number of members; also that if the Conversazione was held at the beginning of the session, instead of the end, it would be an incentive to new members joining the Society, and he thought it was a matter worth consideration. Another point he had mentioned before was the question of more liberal terms of composition for life members. He was aware that the matter had been considered by the Council, but he still thought something might be done respecting it. He considered the elementary examinations to be very desirable, as they ensured students being well grounded in the elements of the subjects they took up.

Sir HENRY WOOD returned thanks for this expression of confidence in himself, and in the other officers of the Society.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. the Duke of Saxe-Coburg and Gotha, K.G.

H.R.H. the Duke of York, K.G.

Sir Frederick Abel, Bart., K.C.B., D.C.L., D.Sc., F.R.S.

Duke of Abercorn, K.G., C.B.

Lord Avebury, D.C.L., F.R.S.

Sir Benjamin Baker, K.C.M.G., F.R.S.

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.

Lord Belhaven and Stenton.

Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.

Michael Carteighe, F.C.S.

R. Brudenell Carter, F.R.C.S.

Sir Edwin Durning-Lawrence, Bart, M.P.

Sir John Evans, K.C.B., F.R.S.

Henry Graham Harris.

Sir Charles Malcolm Kennedy, K.C.M.G., C.B.

Sir Villiers Lister, K.C.M.G.

Ludwig Mond, Ph.D., F.R.S.

Hon. Richard Clere Parsons.

Sir Owen Roberts, M.A., D.C.L., F.S.A.

The Master of the Rolls, G.C.M.G.

Lord Strathcona & Mount Royal, G.C.M.G., LL.D.

Sir Thomas Sutherland, G.C.M.G., M.P.

Sir William Henry White, K.C.B., LL.D., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

Sir John Wolfe Barry, K.C.B., F.R.S.

Lewis Foreman Day.

Sir William Lee-Warner, K.C.S.I., M.A.

Sir Westby B. Perceval, K.C.M.G.

Sir William Henry Preece, K.C.B., F.R.S.

Sir Walter S. Prideaux.

Sir William Chandler Roberts-Austen, K.C.B., F.R.S.

Alexander Siemens.

Joseph Wilson Swan, F.R.S.

William Luson Thomas.

Professor John Millar Thomson, LL.D., F.R.S.

John I. Thornycroft, F.R.S.

TREASURERS.

Sir Frederick Bramwell, Bart., D.C.L., F.R.S.

B. Francis Cobb.

SECRETARY.

Sir Henry Trueman Wood, M.A.

On the motion of the CHAIRMAN, a vote of thanks to the scrutineers was carried unanimously.

Sir STEUART COLVIN BAYLEY proposed a hearty vote of thanks to the Chairman of the Council, Sir John Wolfe Barry, to whom the Society was deeply indebted, and also to Major-General Sir Owen Tudor Burne, who had taken his place on the present occasion.

The resolution was seconded by Mr. J. J. VEZEY, and carried unanimously.

The CHAIRMAN, in acknowledging the vote of thanks on behalf of Sir John Wolfe Barry, said Sir John's term of service had now expired, and he felt sure that all the members of the Society would agree with him that Sir John Barry had performed most valuable work for the Society since he had been Chairman. He also thanked the meeting for their expression of confidence in himself.

The meeting then adjourned.

Correspondence.

THE INDUSTRIAL DEVELOPMENT OF INDIA.

I was abroad when Mr. Baines read his interesting and exhaustive paper on "The Industrial Development of India," and in consequence of continual travelling, the Society's *Journal* of the 8th has only just reached me, which must be my apology for the lateness of my remarks.

It is a little disappointing to reflect that a paper so admirably framed to elicit opinions and to promote discussion, should not have entirely fulfilled its purpose, and it was perhaps inevitable that the opinions expressed should have had a tendency to wander into side issues. Doubtless if everyone could come forward and state from local knowledge what industry in India could be planted here, and what improvement effected there, many side issues which affect the general advance of industries would be satisfactorily settled; but such issues as glass blowing and art handicrafts generally, hardly touch the millions whose condition it is sought to improve by the introduction of industries pure and simple. The real questions at issue may be narrowed to the consideration of one position, viz., are Indian industries to be allowed to grow naturally as advocated by Mr. Baines, or are they to be stimulated by technical education as advocated by Sir M. M. Bhownaggree? These points seem to me to be all important, but before considering them it must be understood clearly what Sir M. M. Bhownaggree means by technical instruction. On the one hand we have the education of the eye and hand, supplemented by a thorough knowledge of the properties of materials; on the other we have a kind of workshop education, in which youths are taught to handle tools and implements, and to spoil, more or less, the materials placed before them. If the first form of technical instruction is meant, we cannot have too much of it, not only in India, but throughout the whole world, for hitherto all education has been one-sided, and the youths in so-called technical schools are, without such education, no more fit to handle tools and implements than a youth without a knowledge of arithmetic is fit to fill the post of banker's clerk. It must be always borne in mind that the necessity for technical education in England has arisen from the failure of the apprentice system, and that no practical man would advocate its introduction in supercession of that system. Now in India there is no such failure, the old apprentice system is working now as it worked in past years, and as it will continue to work if not interfered with by fussy legislation. If it is possible to graft on the present apprentice system real technical education and superior knowledge of materials, instead of that playing with tools and implements which passes under the name of technical education, Indian industries will gradually improve and eventually move forward to a front rank. In India technical education seems to be in the hands of teachers who can hardly be called experts themselves, or they would be conscious of the great difference between an institutionally-trained artisan and an educated apprentice. Technical colleges are at present however so few, that their influence is too feeble to affect the millions, but it may be otherwise if Parliament is roused and pressure brought to bear on the Government of India, resulting in mischievous legislation. At present the Indian artisan is, in his way, one of the best in the world, and it would be a great pity to spoil him.

With regard to technical education generally, even in England, where the failure of the apprentice system has made it an absolute necessity, many people whose opinions are entitled to respect doubt whether it will achieve the success anticipated, and, again, it is an error to attribute the wonderful strides which Germany has made of late years in the commercial world to technical education alone, other factors must be taken into consideration—frugality, a lower wage, longer hours, and mild beverages.

In conclusion, I would beg leave to endorse Mr. J. D. Rees' opinion not to interfere by legislation with the system of labour which has grown up, and to this I would add, to confine all technical instruction to the education of the hand and eye only, which will secure the necessary aptitude to pursue with ease any industry or any industrial art.

B. CHISHOLM.

Boslandew-house,
Paul, near Penzance,
18th June, 1900.

General Notes.

CHEMICAL SOCIETY. — The Nilson Memorial Lecture will be delivered by Professor Otto Pettersson, of Stockholm, at the Society's Rooms, Burlington-house, on Thursday evening, July 8th, at 8.30 p.m.

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FRIDAY, JULY 6, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The results of the Examinations held at the end of last March are now ready, and an advance copy has been sent to each centre of examination.

Copies for gratuitous distribution to each candidate who attended the examination will shortly be sent to each centre. Additional copies can be obtained, price 6d. each.

The dates for the Examinations in 1901 will be Monday, Tuesday, Wednesday, and Thursday, March 18th, 19th, 20th, and 21st.

Proceedings of the Society.

INDIAN SECTION.

Thursday, May 24; the Right Hon. Sir Francis Henry Jeune, K.C.B., D.C.L., in the chair.

The paper read was—

ENGLISH AND ANGLO-INDIAN CRIMINAL PROCEDURE: A COMPARISON.

By Sir John Scott, K.C.M.G., D.C.L.

The other day I met an old friend who had been an eminent Chief Justice in India, and I told him I was going to deliver a lecture at the Society of Arts on English and Indian Criminal Procedure. "That is an awfully tough job for a busy man" was his not very encouraging reply. I hope when you have heard my address you will not be inclined to cite the old saying with a slight modification—"Fools rush in where angels and Chief Justices fear to tread."

My pretensions for the task are not great. But I was a practising barrister in England, and I had a good deal to do with English Criminal Law. I was subsequently an Indian Judge, and had much to do with Indian Criminal Law. Then I was a long time in Egypt, where French Law prevailed, and I had a certain success in grafting on to codes made on the French pattern various Anglo-Indian, as well as British rules. In the course of this experience I had occasion to consider and compare the two systems we are to discuss to-day, and as the Society of Arts kindly offered me hospitality, I propose now to offer you some of the results of my studies.

We have nothing to do to-day with Substantive Criminal Law; that is the law which defines what constitutes a crime, divides crimes into classes, according to their importance, and assigns to each the punishment required in the interests of society. Our subject is Criminal Procedure, which has the threefold function of preventing as far as possible the commission of crime, bringing criminals to justice, ensuring the punishment of the guilty and the acquittal of the innocent. It may be as well here to state that I do not propose to go into minute details as to how each of these objects are attained in each country. We have not time. We should not see the wood for the trees. It is best, I think, to sketch the broad outlines, and dwell on the important differences as they occur, leaving minor divergences alone.

We are met on the threshold by what is perhaps the broadest difference of all. The Indian Criminal Procedure is codified. English Criminal Procedure remains a body of uncodified law, to be found in many books and decisions, representing the growth and development of the English nation. The one came from the outside, the other grew up from within; but both came from the West. Here I would venture to say three things: (1) Although this code was an importation, it has given great satisfaction to the Indian people (the late Mr. Manomahan Ghose, a leading native Indian lawyer and reformer, said in 1895: "Justice was never better administered, and life and property were never more secure, in the history of India than they are at the present moment. Even the masses of the people in Bengal, with whom I come daily into contact, have learnt to appreciate the blessings of a pure administration of

justice"); (2) Although some parts of the Indian Code are not suitable to the needs of England, there is much in it that is better than what is to be found in our own system; (3) A code is much better for *any* people than an uncodified body of law.

I know these are bold assertions. I should like to say two words at once as regards the third. An eminent British jurist once denounced codes as rigid, and extolled an uncodified system, because it was flexible. Adjectives are terrible weapons when used with skill by an eminent man. But I think in the present case these two adjectives were not applicable. Case law, if it is law at all, must be just as definite and just as much founded on principle as a properly constructed code, and if a Judge can be trusted to fit new circumstance to old cases, he can also be trusted to fit his code to new facts. A collection of rules of procedure in some 150 pages, does not make those rules one jot more rigid or less flexible. I would go further and say, as regards all codes properly constructed—that is to say, codes as a collection of principles—that they are no more rigid than the principles themselves; only in the one case you have the principles ready to your hand, and in the other case you have to search for them in a thousand volumes. I would go one step further. If Parliament were not so busy with what is considered more urgent legislation and had had time to entrust the compilation of codes to a body of eminent jurists with full powers, after the example of Napoleon, we should have had codes long ago. It really all depends on who makes your codes. If you find the right man to make them codes are an immense blessing to a nation. Before I leave this branch of the subject I should like to lay before you Sir James Fitzjames Stephen's account of the genesis of this Indian Code of Criminal Procedure.

"I had charge of the Code of 1872, and carried it through the Legislative Council. My own personal share in the work consisted mainly in making the first draft, and especially in devising the arrangement of the Code, presiding at the committees to which it was referred, and studying the information respecting it, which was supplied by others. The Code was considered and passed according to the routine followed in the Indian Legislative Council on all occasions. In the first place, the Code, having been drawn and introduced into the Legislative Council, was published in the *Gazette* and circulated throughout India, every local government being required to have it thoroughly examined by experienced officers and to return it to the Government of India with such observations and suggestions as they considered proper. The result of this was to produce a great amount of official criticism, embodying the experience of officers in all parts of the country, and bearing upon every, or nearly every, provision of any importance which the Code contained.

"When all these suggestions were received, the Code was referred to a Committee of the Legislative Council, consisting, I think, of fourteen or fifteen members, comprising men of the largest experience and highest position from every part of India. The committee met five days in the week, and sat usually for five hours a day. We discussed successively the substance and the style of every section, and different members assigned for the purpose brought before the committee every criticism which had been made on every section, and all the cases which had been decided by the High Courts on the corresponding sections of the Code of 1861. These discussions were all by way of conversation round a table in a private room. When the report was presented the Code was passed into law after some little unimportant speaking at a public meeting of the Council. This was possible, because in India there are neither political parties nor popular constituencies to be considered, and hardly any reputation is to be got by making speeches. Moreover, everyone is a man under authority having others under him.

"The point which made an ineffaceable impression on my mind was the wonderfully minute and exact acquaintance with every detail of the system displayed by the Civilian members of the committee. They knew to a nicety the history, the origin, and the object of every provision in the Code which we were recasting. Such a section, they would say, represented such a regulation, or such an Act. It was passed in the time of such a Governor-General, in order to provide for such and such a state of things, and we must be careful to preserve its effect. To be present at, and take a part in, these discussions was an education, not only in the history of British India, but in the history of laws and institutions in general. I do not believe that one Act of Parliament in fifty is considered with anything approaching to the care, or discussed with anything approaching to the mastery of the

subject with which Indian Acts are considered and discussed."

May I briefly summarise the advantages of a code? The law is comprised in such limits that every individual in the country is able to know it. Once law is popularised, and the people can understand it, good government becomes easier. Then the lawyers can have it at their fingers' ends—the Judges can apply it without hesitation. All these reasons are immensely strong in a backward country, but they have considerable strength in every country. Of course, in a country such as India or Egypt, where there is a feeble Press and no sound public opinion, and the population is only on the edge of civilisation, a code has more advantages than it would possess in a country like England, where a people, law-abiding, well trained in public as well as private education, have law administered by admirably-trained Judges who are stimulated by a most able and well-informed bar. But at present, in England, the laws are so voluminous and so difficult to understand that a whole life of unremitted labour is necessary to acquire a knowledge of them.

One more observation before I leave the subject of codification. Every other nation save the United Kingdom, with any claim to civilisation, from the Eastern Empire of Rome under Justinian to Napoleon, who goes down to posterity, not on account of his barren conquests, but by reason of his codes, to all the modern countries of Continental Europe, to the United States, or the major part of them, to a large number of the Colonies of Great Britain herself, to India, to Turkey, Cyprus, Egypt, even to our latest acquisition, the Soudan, all have codified their laws. England stands alone. I feel I have reason on my side, but I have many opponents who prefer to stand on the ancient ways, and I can fully understand that very able men should have a positive liking for a difficult system which, in spite of its difficulty, they have learnt by sheer ability to administer admirably.

Now, I will leave a thorny subject, and go on to the examination and comparison of the two systems. As the Indian system is codified it is easier to make it the basis of comparison, and I will go step by step through the divisions of the Indian Code. In the matter of jurisdiction each system is territorial, with certain differences which are necessary to the different circumstances of the two countries. The rules, for instance, as regards crime committed on the high seas are peculiar to England, and certain rules as regards crime committed in the Native States are peculiar to India. In short, India has taken on this point all she ought to take from England and there is nothing in the Indian system for England to copy. The rule is applied in both countries which is neatly expressed in the French Code, *Nul ne peut être distrait de ses juges naturels.* But great latitude is allowed as regards the question in each case, "who are the natural Judges"? Next, there is an elaborate series of definitions in the Indian Code which are of the greatest use to the Judge and practitioner, but would hardly be of the same use to the administrators of justice in England.

As regards the constitution of the Courts, England again has nothing to take from India, and India has received all she can from England. The judicial organisation of England has grown with her growth, and is a fabric centuries old which can hardly be touched at any point without endangering the whole system. The organisation of Indian Courts is mainly of recent origin, founded on the needs of a backward people. But due respect is paid to old customary organisation. The village system, with the village head as judge in matters of small moment but daily occurrence, is retained, and he has even the power of imprisonment up to twenty-four hours, as well as the power to fine. The unpaid magistracy of England finds some slight equivalent in the Justices of the Peace, but they play a very small part in the administration of justice, save as regards European subjects. Petty Sessions, Quarter Sessions, Recorders' Courts, University Courts, Central Criminal Court, Assizes, Queen's Bench Division, Peers of Parliament, House of Lords, are all replaced by a graded and paid magistracy, who rise from low pay and limited jurisdiction through the grades of third, second, first-class Magistrates, Presidency Magistrates, District Magistrates, Assistant Sessions Judges, Sessions Judges, to the apex of the Judicial Hierarchy—the High Court.

At this stage we come across another vexed question. The District Magistrate, whose powers are not only judicial, but also superintendent as regards the subordinate judiciary, is an executive as well as a judicial officer. This dual authority is not allowed in England. The magistrate who administers justice here is only a magistrate; he is not held responsible for the

peace of his district. The officer so responsible is entirely separate from the magistrate. There is no doubt of the propriety of this separation. But many authorities in Indian questions hold the theory inapplicable to India, or, at any rate, agree with Lord Dufferin, who put it aside as "a counsel of perfection." The objections raised are twofold—financial, because of the increase of the judicial staff that would be required; political, because of the loss of prestige which would ensue to the executive so essential to good administration in a backward country. Moreover, it is urged, with reason, the Collector, who is the District Magistrate, knows the people, and is able to act with great rapidity in important cases, whilst he does not attach undue importance to small offences.

I admit the force of these objections. India cannot at present bear any further fiscal burthens, and prestige is a powerful factor in all Eastern countries. It was easy for Montesquieu to sit in his armchair and discourse upon the strict separation of the functions of government, but in practice they can hardly be kept asunder by a hard and fast line. Even in England a hundred years ago the line of separation was often overstepped, and this counsel of perfection must take time for realisation. But I submit such a separation, as far as it is possible, is an essential to all good government.

It is held nowadays a part of Criminal Procedure to make provision, not only for the detection of criminals and for their punishment, but also for the prevention of crime. India goes further than England in this respect. Security for keeping the peace can be required from persons thought likely, on reasonable grounds, to break the peace; from persons found in hiding under circumstances that seem to show an intention to commit an offence; from persons who have no ostensible means of subsistence and can give no satisfactory account of themselves; from old offenders; from persons who threaten injury to property. It is also the duty of the village head to take all precaution against crime and especially robbery. Additional police can be quartered in disturbed districts and their cost is thrown on the district, whilst the inhabitants of a whole area can be made to pay compensation to inhabitants who have suffered from misconduct. Magisterial powers in this respect are not so wide in England. We have industrial schools and reformatories, certain provisions are made on behalf of neglected children, and we have police supervision of old offenders; but I think I am right in saying that all these measures though preventive as well as punitive must be founded, save in the case of children, on some actual breach of the law. Probably the two plans are excellent respectively for the conditions of the two countries. But I have often thought that crime would be less in England if every member of the community were called upon, as a simple matter of course, either to show by the nature of his employment, by his trade, by his profession, or his accumulated fortune, that he is leading an honest life, and on failure to do so he should submit to police supervision.

However, I do not wish to insist on what might be called grandmotherly legislation if applied to England, and I will leave the prevention of crime and pass on to the wider subject of its detection and its prosecution. In the matter of police investigation of offences, arrest, and committal for trial, there is not a great difference. Detention by the police, magisterial hearings, bail, confessions, are all controlled in much the same way. But in the matter of prosecution there is a capital difference. In India there is a genuine and thorough system of public prosecution of crime. Every case of any importance must be conducted by the Public Prosecutor. No other person is entitled to do so without the special leave of the Court. In England the private prosecution of crime still mainly prevails. In the Prosecution of Offences Acts of 1879 and 1884 there is no doubt the nucleus of a public system, but the practical outcome is very small. In 1897 (I quote from the latest issues of criminal statistics) there were 11,215 indictable offences tried before a jury and 39,521 disposed of summarily. Of these only 414 were prosecuted by the Public Prosecutor. Yet from 1893 to 1897 the annual average number of offences against the person reported to the police was 3,853, and of these only 2,662 were brought to trial. These figures are poor proof of the efficiency of the present system of prosecution of crime. Again, the average annual number from 1893 to 1897 of offences against property, with violence, reported to the police was 7,870, and of these only 2,015 were brought to trial. This set of figures does not, any more than the other, favour the maintenance of the present system of prosecution of crime. *Stare super antiquas vias*, I know, is our most excellent motto, but we must not linger too long on lines that are obviously wrong. And I should like here to bring in a point of personal experience before

I say a few words why I think we are wrong, and to show why I think we persist too much in always thinking we must be right. For eight years I sat in the International Court of Appeal in Egypt, where I had as colleagues representatives of the other Great Powers. We were all lawyers, and very naturally discussed questions of law from very different standpoints, quite apart from the disputes which came before us, which we had to decide according to French law. I always found it difficult to get a hearing, and I remember well a remark of the President: "Vous autres Anglais vous avez un systême qui est parfait pour vous mais qui ne convient à aucune autre nation et vous ne voulez rien adopter des autres. Vous croyez votre systême parfait."

The civilised world was at one time divided into two camps as to (1) the conduct of the prosecution, and (2) of the preliminary investigation of crime. One party held that the prosecution of crime should be started on private initiation, because the person injured could alone be relied upon to have taken action honestly, and from no motives of persecution or vindictiveness. The other party maintained that every criminal breach of the law was primarily an injury to society, and should be prosecuted by society, and not left to any individual to punish. In every other country save our own the second theory now prevails. It is now held almost universally that all crime is a violation of public right; its punishment is a public duty, and ought to be considered the proper function of the Government charged with the maintenance of the security to the public of life, person, and property. Again, one party held as regards the preliminary investigation of crime that the accused should be examined in secret, and not be allowed to have any communication with his friends, in order to facilitate the proof of the offence charged. The other party held that a man should be deemed innocent until he was proved guilty, and was entitled to a public inquiry and every means of defence. All Anglo-Saxon races held the second system to be right, whilst the Latin races held by the other. I am glad to say the English have won, and even France eighteen months ago abolished to a certain degree the secrecy of their preliminary inquiry. As regards the proceedings at the trial of a criminal offence, in both India and England, there is the same publicity, the same care that evidence should be absolutely trustworthy, not based on mere hearsay, the same care that the accused should have every right of defence.

Until last year India was in advance of England as regards the admission, compulsory or otherwise, of evidence from the accused himself. In former days it was held to be a cardinal rule of natural equity that the accused should not be examined, because he ought not to be forced to incriminate himself. This theory has not been absolutely abandoned. He can now offer himself for examination. But although he has not been obliged to do so, his silence may be construed to a certain extent against him. In India, they hit upon a very happy mean. The Court at any stage, without previously warning the accused, may put such questions to him as the Court considers necessary, to explain any circumstances appearing in the evidence against him, and must, at the close of the case for the prosecution, give him an opportunity to explain the circumstances which appear to be against him. I may add, as a matter of personal experience, that this plan has had most satisfactory results, sometimes in favour of the accused, sometimes against him, but always tending to bring out the truth. I am inclined to think, but with the greatest submission, that this power entrusted to the Judge is preferable to the discretionary right given by the recent Prisoners' Evidence Act to the prisoner to tender himself in evidence or not, according to his desire.

Grand Juries were abolished in 1864, on the initiation of Sir Henry Maine, when he was Legal Member of Council in India. Some audacious reformers maintain they are useless in England. At any rate, in India they had proved to be worse than useless, often obstructions to justice, whilst the grand jury list seriously depleted the list of petty jurors that was too scanty already. Sir Henry held rightly that the Grand Jury was wholly unadapted to the wants and circumstances even of the European portion of the community in India. In substitution, the Judge of the High Court, who is to try the case, is enabled, when he thinks a charge is clearly unsustainable, to make an entry to that effect on the charge, and such an entry has the effect of a *nolle prosequi* upon the charge, but does not operate as an acquittal until three years have elapsed.

The ordinary jury system obtains to some extent in India, but is by no means universal. Outside the Presidency towns it is hardly applicable, and is seldom applied. In the provinces, Judges are assisted by two assessors, whom they choose themselves, and whose opinion they are not bound to accept. In the

Presidency towns the number for the jury is 9, instead of 12, and the vote of the majority (of 6 to 3) can be accepted as final—if the presiding Judge does not think it against the weight of evidence. As far as my Indian experience goes, the jury system is admirably fitted to a nation of well-educated citizens, all realising a certain duty to the State, but it must be applied with the greatest caution in a country where education has not yet developed a strong sense of public duty.

Let me give an instance. In one of the first trials for murder I conducted in India, a big, strong fellow, of 24, was tried for murdering his nephew for the sake of a silver cord the boy wore round his loins. The charge was proved up to the hilt, there were absolutely no extenuating circumstances, yet the jury debated for hours, and only at 10 o'clock at night came in with a majority of six out of nine for a verdict of guilty, but with a strong recommendation to mercy. I asked for their grounds: "On account of the prisoner's youth" was the reply. I found afterwards that some of the jurymen belonged to a caste that would not take the life of any animal, still less that of a human being, and they had got the others to insist on the recommendation to mercy.

Passing on to the next stage in the Criminal Trial, every English lawyer, naturally imbued with the necessity of finality in criminal proceedings, must be almost shocked at the number of appeals which are allowed by the Criminal Procedure Code in India. I think I am right in saying that in every criminal proceeding in India, of a definitive character, an appeal is allowed. I think I am also right in saying that in any criminal proceeding of any importance in England, an appeal is almost impossible.

This divergence, of course, can be explained to a great extent by the difference between the two peoples. Excellent and highly-trained Judges, supervised by a strong bar working in the light of an educated public, and an enlightened Press, are very unlikely to go wrong, and a speedy finality is of immense advantage in criminal proceedings. The Indian Judiciary in the provinces has not the advantage of the same stimulating supervision, and an appeal from them may be advantageous although it might if extensively applied, be mere waste of time in England. But the control of an appeal is not the only control established by the judicial organisation of India.

Apart from the right of appeal which is given to the accused, other methods have been devised in order to prevent injustice. There is a kind of hierarchical system of supervision established, of higher magistrates over those who are subordinate, and the High Court acting as the chief superintending power. Monthly reports have to be made of cases decided, each Appellate Court has its duty, and the High Court has revisional powers over the decision of every tribunal in its division. The Government has even the right to appeal against what it considers an improper acquittal. These powers of interference with judicial independence must seem strange to the English lawyer. Yet if you will allow me to speak from personal experience, the right of superintendence given to the High Courts is of immense utility in the development of a good judiciary in a country that is not wholly civilised. I went from India to Egypt on what was at the time considered rather a forlorn hope. I was asked to reorganise what was reputed to be an incapable and corrupt judiciary. Almost my first proposal was adopted from India, and consisted in the establishment of a Judicial Committee of Supervision, composed of the best lawyers in the country, who had no right to interfere with any decision, but could call upon any Court to justify the decision it had given. This arrangement succeeded even beyond my expectation. But I only refer to it here, in order to show that what in English eyes may seem improper interference with a Judge has most excellent results in a country like India or Egypt.

The powers of revision and superintendence given to the High Courts in India would, of course, find no place in the judicial organisation of England. But the right of criminal appeal which is created by the Indian Criminal Procedure Code deserves consideration. It is worth while to give in some detail the rights of criminal appeal established in India. There is, of course, no appeal in cases where the accused pleads guilty. There is no appeal given in petty cases where the sentence does not exceed one month, or the fine does not exceed 50 rupees. There is no appeal in sentence of imprisonment in default of payment of fine.

There is obviously no appeal in a sentence of whipping. There is no appeal in certain summary convictions, where the sentence does not exceed three months, or the fine does not exceed 200 rupees.

I may say, by way of parenthesis, this is a great advance on Continental systems, which

allow an appeal in all cases, however trivial; and I availed myself of these Indian rules when we modified the Egyptian Criminal Procedure.

Now, I pass to the cases where an appeal is allowed.

There is an appeal in every case of greater importance than those specified above. An appeal is even allowed on behalf of Government in the case of an acquittal, although the acquittal may have been confirmed by an Appellate Court. The Court of Appeal has power to call for records of inferior Courts, and when on examining the record of any case it considers that an accused person has been improperly discharged, it may cause him to be arrested and re-committed for trial. He is, of course, allowed to show cause why the commitment should not be made. The Court may also make further inquiry into the case of any accused person who has been discharged.

Appeal lies on matters of fact as well as matters of law, excepting where the trial is by jury, in which case the appeal lies in matter of law only. But the alleged severity of a sentence is deemed to be matter of law. The appeal is made by petition, and if the appellant is in gaol the officer in charge of the gaol is bound to forward the petition to the Appellate Court. If the Appellate Court considers there is not sufficient ground for interfering, after hearing the appellant or his pleader, it may dismiss the appeal summarily. If it decides to hear the appeal, it is empowered to reverse the finding and sentence, to acquit and discharge the accused, to alter the finding, or to reduce the sentence. Pending the appeal the Appellate Court may order that the execution of the sentence be suspended, and the appellant be released on bail.

In the performance of its duty of judicial superintendence, the High Court examines the records of the proceedings of inferior criminal courts within its jurisdiction, for the purpose of satisfying itself of the correctness, legality, propriety, and regularity of the proceedings, and it may then not only exercise any of the powers conferred on a Court of Appeal, but it may also enhance the sentence.

Such is the system of criminal appeal, revision, and superintendence in India. Its entire adoption in England is, of course, out of the question, but a Court of Criminal Appeal of some kind, for which the system of Indian Criminal Appeal could be utilised perhaps as a basis, seems desirable.

The present state of things is not satisfactory. The arbitrary division of felonies and misdemeanours still obtains, and while you can, on good cause shewn, have a new trial in a misdemeanour, you cannot in a felony. In the latter case you can only ask the Judge to reserve a point, or obtain a writ of error, on the *fiat* of the Attorney-General, and at least five Judges are required to compose a Court of Criminal Cases Reserved. Yet it seems to me that every person convicted by a jury should be able to obtain a new trial on strong and sufficient reasons.

Sir James Fitzjames Stephen, as member of a Royal Commission which considered the subject, was not only strongly in favour of a Court of Criminal Appeal, but drafted a Bill forming a code of Criminal Law, of which Criminal Procedure made part, which would probably have become law if Parliament had not been too much occupied with other things. He was, I believe, supported by Lord Cairns, Sir John Holker, Lord Blackburn, and Lord Justice Lush. Three times a Bill was laid before Parliament, and three times it was postponed.

Sir Henry Maine, on the other hand, maintained that even in India the natural advantages of Courts of First Instance were greatly underrated, and far too high a value was set on the corrective power of Courts of Appeal. He insisted that the proper course was to improve the first instance Judge up to the point when the appeal could be safely dispensed with. He admitted, however, that appeals have, at any rate, one advantage, inasmuch as they serve as a mode of supervision, and force a negligent Judge to keep his work up to a certain standard. Bentham, who is an equally high authority, maintained that there should be an appeal in every case. Such latitude is not given, even in India. It seems to me that an appeal on points of law only in jury cases, and on points of law and fact in other cases, where the sentence exceeds a certain limit of imprisonment are the true limits of criminal appeal. The superstitious reverence with which the uneducated Indian native regards an Appellate Court, and especially a High Court, as a Court of Appeal, will for a long time to come make it desirable to maintain the system of appeal. To the Hindu the High Court is as much his palladium of liberty as the jury system is to the Englishman. I will give you an authentic story as an illustration. Certain tribes believed they had a right to certain land, and that right was disputed by

their neighbours. They went to law on the subject, and they were beaten in the Court below. They knew that there was a superior power, which could still decide in their favour, which was called the "Igh Court." They instructed their lawyer to take the case before this superior power, whom they conceived to be a kind of God. Then in the dead of night they ascended a high hill and solemnly sacrificed—some say a child, some say a sheep—to propitiate this unknown god who held their fortunes in the hollow of his hand. I am sorry to say that they still lost their case.

I have reached the limit of time which I had assigned myself for this paper. I have only treated the subject imperfectly. To treat it exhaustively would have taken me far beyond the limits of an ordinary paper, and infinitely beyond your patience. Before I conclude, I should like to recall to your memory de Tocqueville's remark that the conquest and government of India is the greatest achievement in the history of England, and I would add that whatever blunders of an administrative character may have been made in the past, very few blunders have been made in the gradual development of the administration of justice. A Brahman is reported to have once said to Sir Monier Williams, "The Sahibs do not understand us or like us, but they try to be just, and they do not fear the face of man." To that tribute the following statement made by the late and much lamented great leader of the Indian Mohammedans, Sir Syed Ahmed, might be added, "Of all the innumerable blessings of the British rule, the one my countrymen esteem most is justice." Justice in their eyes means peace and order, which, in other words, means security to life and property, the sole end and aim of Government." Nor are we doing this to-day by any means solely through British agency. Education has been fostered as much as justice, and the judiciary of India now is largely and increasingly composed of Indians. The higher posts are still held in the majority by the Barrister Judge, and by what is known in India as the "Heaven Born," *i.e.*, the Indian Civilian from England. But native instruments are now excellent. Sympathy and antipathy are no longer created in Indian life according to religion or relationship and a sense of civic duty is gradually growing up. To show to what extent the Indian nation is now utilised in administration I will cite a few figures from the statistics of the Bombay judicial service of to-day.

In the High Court there are two native and five European Judges. Amongst the District and Sessions Judges there are five natives to twelve Europeans. Of the Small Cause Court Judges, there are eight natives to two Europeans. The whole body of subordinate Judges throughout the peninsula (there are several thousands in India) is native. Of the Magistrates of the first-class in Bombay, 127 are natives to 61 Europeans; of the second-class, 259 are natives to 8 Europeans; of the third-class, 255 are native to 8 Europeans. Finally, over 14,000 native heads of villages administered minor criminal justice. I think it will be admitted on all hands that England honourably performs her task as trustee for India and does her duty in the admission of the Indians to a due share in the administration of justice.

I thank you for having listened to me with so much patience.

DISCUSSION.

The CHAIRMAN said all would agree in tendering a vote of thanks to Sir John Scott for an extremely able paper, but they would also agree in differing from him in deprecating his own qualifications for the task he had undertaken. He did not refer merely to Sir John Scott's personal qualifications, but throughout his career he had been placed in an exceedingly good position to be able to take an unprejudiced and complete view of the legal institutions of this country. He had been engaged in the practical administration of the law in India, and afterwards in the still more complete work of reorganising the judicial system of Egypt, both as regards law and procedure, and the result was that he had been compelled to bring the resources of a clear mind to consider what really lay at the foundation of judicial systems, and see what in the English, the French, or any other system, was excellent or desirable, and, on the other hand, what were the peculiarities which his French friends appeared to have estimated at something like their true value, although we might estimate them at an exaggerated value. That enabled him to challenge some of what, no doubt, were our most cherished institutions. He did not dispute that there might be some persons who were inclined to think that he had drawn aside, with a somewhat irreverent hand, the curtain which veiled some aspects of our system, as, for instance, the Grand Jury. He was bound to admit that a country like India could get on very well without Grand Juries, and even found they were rather an obstacle to the progress of satisfactory judicial work. We, for many years, had been accustomed to venerate Grand Juries, and to regard them

as necessary. He did not profess to say what exact, useful functions Grand Juries did exercise, but a great many who were more experienced regarded them as extremely necessary to our system. He was bound to add that he once had to defend Grand Juries, and was not very successful. In the law of Canada it was provided that all central features of English criminal procedure should be observed, and they set up most of the things to which we were accustomed, but they never set up Grand Juries, and on a famous occasion when a great criminal was brought to trial for his life in Canada, it fell to his lot to argue before the Privy Council, that inasmuch as he had not been brought before a Grand Jury he had not been tried according to the admitted jurisprudence of the country, because an essential feature of English, and, therefore, of Canadian procedure had been wanting. He did not get very far with his argument, and the Privy Council were taking a decided view that a Grand Jury was not an essential feature. In all human probability they would have so decided had it not happened that during the course of the argument a telegram was put into his hand from Lord Lansdowne, who was then Governor-General of Canada, that the man had been executed just two hours before. Sir John Scott had also thrown some little doubt on the perfect wisdom of Common Juries. He did not propose to touch on that subject, because they were all brought up to believe that juries were the embodiment of human wisdom. He knew they were extremely convenient, and he should be very sorry indeed to have to decide questions which he now had the happiness with a waive of the hand of being able to put into the jurisdiction of juries, telling them that the matter was entirely for them. Whether if they knew, as in a particular case Sir John Scott appeared to have known, what were the reasons which animated juries in all the decisions to which they came, it might be they would not regard juries with quite the same veneration, he could not say, but fortunately that matter was sealed. Sir John Scott had partly touched on a subject about which there might probably be a difference of opinion. He had described the advantages of a code, and he confessed to being somewhat of two minds on that subject. The day had gone by to a great extent when it was discussed with zeal, energy, and even some excitement He remembered hearing in that very room, a great many years ago, a most noted debate as to the advantage of codes, and coming away with the conclusion that for civil purposes codes were not by any means so desirable as they seemed. He did not for a moment yield even to Sir John Scott in admiration for the work of the great Napoleon in the French code. He had a tremendous problem to solve. He had to deal with a country which he was endeavouring to weld into a homogeneous whole, but which was separated province from province by different institutions and different customs, which meant different systems of law. He felt that until you could amalgamate the different systems of law and make France one country in law you never would make her one country in fact. He succeeded in a task which was almost superhuman. One could imagine what difficulty there would be now if any one suggested it was not desirable to have one system of law at one end of this island and another at the other, and endeavoured to weld the Scotch system and the English. But when you came to codify civil law, he confessed he had very great doubts. He feared you got a simplicity which was fictitious, and even if you succeeded at the cost of enormous labour in forming a civil code, the result would begin again that had been going on here for many years, the code would be overlaid by decisions after decisions, interpreting and eventually obscuring the original text of the code itself. He believed that process to be almost inevitable, because that was what had happened in one country. In Lower Canada they adopted the French code, or something very like it, with a few adaptations. At first the Judge, strong in the integrity of the code, said, "We will listen to no precedents; we decide by the code, and the code alone, which is our sole guide." That lasted a little while, and then lawyer after lawyer got up and said, "I do not ask your Lordship to listen to precedents, because the day for that has gone by, but at the same time it might be interesting and curious for your Lordship to know what the Court of so-and-so, in the case of 'Jones *v.* Smith,' a few days ago, said about this very article of the code." The Judges, of course, yielded to the temptation, their curiosity was too much for them, and the next time the lawyer would be a little bolder, and he would say: "Your Lordship can decide this as you please, but I should like to tell you that it has been three or four times decided always the same way by Courts of the greatest possible eminence." The result had been that gradually there had grown up in Lower Canada volumes of reports, which anybody might see in the Inner Temple, which were precisely of the same character as those which prevailed here. In other words, the English system by its inherent force had defeated the system intended to supplement it. It often happened to him to have French lawyers coming to tell him what the French law was with reference to various points arising in connection with wills, and, of course, they referred to the Code. It always appeared to him that the articles of the Code had absolutely nothing to do with the matter, and they would say it seemed so, but nevertheless the Court of Cassation, the Court of Amiens, or the Court of Lyons put this interpretation on it, the Code meant so and so, and he got a long series of cases decided and very badly reported, and at the end he was quite unable to see the difference between our system of referring to what Judges had decided, and the French system of referring solely to the Code. This, however, only applied to Civil Law, which had to meet every one of

the kaleidoscopic changes in human life, and the combination of circumstances which complicated human life necessarily presented. The endeavour to meet this was an infinite and hopeless task. But it might well be possible, and that was being done in this country, to codify certain branches of law. On bills of exchange you might have got gradually a long series of complicated decisions, some wrong and some right, but, at any rate, making a body of very complicated and obscure law, and it was very useful that that should be put into the definite and simple provisions of a code. From that point you started and went on again. He had not a word to say against that, and he believed no judge of any experience had. There was a further branch of the law in which he agreed that codification was not only possible but desirable, and that was Criminal Law. That was necessarily far simpler, and ought to be less complex than Civil Law either was or could be. It was extremely important, of course, that every member of the community should know precisely what were the crimes which the law considered crimes, and the punishment to which he might be subjected if he offended against them, and also the procedure to be pursued. It was quite possible to put that into a code which would afterwards stand *proprio vigore*, and would not require to be overridden by a series of elaborate and perhaps contradictory decisions. That had been attempted in this country, and had been effected in India by the efforts first of all of Lord Macaulay, then by Sir Henry Maine, and also Sir James Fitzjames Stephen, all of whom contributed a fair share to the making of an excellent workable code. The same thing had been attempted in this country, as Sir John Scott told them, some years ago. Sir James Stephen was employed with Lord Blackburn and another Judge for a considerable time in forming what was, no doubt, an excellent criminal code which, he believed, could be passed into law, but unfortunately it turned out to be impossible. No doubt this was partly for the reason which had been pointed out, that it was very difficult to get any matter through Parliament which any member, and almost every member, would think himself qualified to discuss, and would discuss. He was sorry to say that during the last few years the zeal for legal reform had died away. Whether this would always continue, he did not know; it might be that the time might come when persons holding those positions from which alone great legal reforms could be initiated, would come to the conclusion which was come to some years ago, and we might at any time learn from India that our criminal system might be made more simple, and we might have a clear and simple code. He did not know whether any one present would live to see it, but he was quite sure they were all the better and wiser for listening to such a paper as they had just heard, and comparing our own legal opinions with those of other countries. Very likely they would all think our own in many respects the best, and he was bound to say he did, but they would often find there were some respects in which we might borrow something which might make our procedure and our law even better than it was before.

Prof. Sir FREDERICK POLLOCK, Bart., LL.D., said he had two qualifications for discussing the subject of criminal procedure, one being that some 30 years ago he was marshal to the late Mr. Justice Willes, on the Western Circuit, and accordingly went into the criminal court, though he preferred the civil court as being more interesting and instructive; and once in more recent times, when a few things were stolen from his cottage in the country, and he was politely asked by the chief constable of the county if he would prosecute, but for reasons which his professional brethren would appreciate he preferred leaving the matter in the hands of the county. One point referred to in the paper was the absence in England of any public prosecutor as a rule, and he did not doubt that the figures quoted were correct, but they were to some extent misleading. It was known to everybody who read law reports that the heading in criminal cases was in form almost exactly the same as that in civil cases. It was a litigation between the Crown and the prisoner:—The Queen on the prosecution of John Stiles *v.* Thomas Snooks—in some cases John Stiles happened to be the public prosecutor, but in the majority of cases he did not. But, on the other hand, he was very often the chief constable of the county, and the prosecution was practically conducted by the county; at any rate, the costs came out of the public purse, so that many of the cases which figured in the statistics as private prosecutions were to all intents and purposes public; and in comparing the two systems, all police prosecutions should be reckoned on the public and not on the private side. He did not know whether a more systematic and centralised procedure would work better; possibly it might. This brought in another consideration in which he did not suggest the paper was defective, but he mentioned it for the sake of any younger worker who was disposed to take up these questions. That was the condition of things in Scotland, where there was a system of criminal procedure different from ours, more systematic, and in some respects more advanced. In Scotland the Procurator Fiscal did a great deal of the work done by the examining Judges in Continental countries, and, he was informed, did it very well. He rather thought the preliminary part of the work was done in private. It certainly was until recently, and he was not aware that anybody in Scotland complained of any infringement of the liberty of the subject because the Procurator Fiscal did this without furnishing material for reports in the papers. The Scots' system of procedure, especially criminal, had been far too much neglected by students of Comparative Law, and the vast majority of them on the Continent, at any rate, assumed that the law and procedure in Scotland were

the same as in England, or that the differences were not worth considering. He must except from that remark the admirable work of his friend, Count de Franqueville, on our judicial institutions, which was more complete than any work in any language whatever, because it contained a great many things you could not find brought together in any work published in English. There was another point worthy of attention, and that was the position of the Sheriff in Scotland. There the Sheriff had a different history from that of his brother in England, who had become a purely executive officer, whose functions were practically delegated to someone else, except the ceremonial one of receiving the Judges. The Sheriff in Scotland was a judicial officer with functions roughly comparable, on the civil side, to those of a County Court Judge, but he had considerable criminal jurisdiction as well, and was still an executive officer. He was not sure that the Sheriff exercised his executive jurisdiction on small or ordinary occasions, but he was, in a real sense, charged with the duty of preserving the peace. Nobody in Scotland cried out against that combination of the judicial and executive functions. Remembering these facts, they must not talk too much about the immutable principles of Anglo-Saxon justice. These Anglo-Saxon principles were to a great extent the result of a peculiar series of historical accidents. It was practically certain that if the very early strengthening of the English Monarchy had not given us uniform law and judicial institutions in the middle ages, we should have been driven to have codes a great deal sooner. On the general question of codification, it was very true that there was a considerable difference between the Civil and the Criminal Law, and also between codification of substantive law and codification of procedure. As a matter of fact, our civil procedure was codified, although many people did not know it. We had Rules of Court, which were to all intents and purposes a code of civil procedure, and a great many decisions upon them, a thing which happened to all codes. Fortunately it was possible to revise the Rules of Court without going before a committee of the House of Commons, and they did get frequently revised, and on the whole they had as good a working code as any other code of civil procedure, if not quite as symmetrical. But he very much doubted whether an ordinary man of business was familiar with them, or was aware of the advantages conferred upon him, for example, by Order XIV., which enabled undisputed debts to be recovered in a summary manner. Although he had been an advocate of codification for some 20 years, he did not believe the codification of either substantive or adjective law would have the effect of causing the ordinary man in the street to know much more law than he did at present, but it would make it easier for him to learn something of the elements of it, when he wanted, which would be a good thing so far. On going into the matter seriously, the arguments in favour of codification were more professional than lay, except possibly as regarded the elements of criminal law; but criminal law in this country was well settled, and it was not difficult for any one who wanted to know the substance of it to find it in works like Sir James Stephen's "Digest of the Criminal Law," or others which professed to make that work more readable. As to the old bogey about codification being rigid, Sir John Scott had sufficiently disposed of it. In a reported case on the Sale of Goods Act, which he had just had through his hands, as Editor of the Law Reports, the Court observed that nothing could be more vague than one section, and it went on to observe that that was perfectly proper, because the section exactly represented, and probably was intended to represent, the state of the authorities when the Act was passed. You may make a code as vague as you like; the French codes were extremely vague on many subjects, whether by design or accident he would not presume to say. He thought there was a little exaggeration in one part of the paper as to the prevalence of codes. It could not be said that codes prevailed on the whole in English-speaking countries outside England. Only a few of the United States codified any considerable part of the common law. The same may be said of the English-speaking colonies. They had practically adopted, word for word, all the general codifying measures, such as the Bills of Exchange Act and the Sale of Goods Act, passed by the English Parliament: he did not know to what extent they had adopted procedure codes, but he thought not to any greater extent than we had. With regard to the Indian procedure, it was rather curious that some of the methods were successful modern reproductions of attempts made in our very early history. For instance, the provision that a man must be called upon to give an account of himself, and show that he was living an honest life, was sought to be attained long ago in England by the institution called "Frank-pledge," and there was a document called "the Statute of Frank-pledge" (though it was not a Statute) going through various categories of persons who were liable to be accounted as rogues and vagabonds, such as those who sleep by day, and wake at night, who live well and drink well, and have no goods. But these excellent mediæval institutions fell out of use, if ever they were of much practical use. As to the general state of our criminal procedure, he did not think we need be at all mealy-mouthed about it. Considering its history, the wonder was not that it should be defective, but that it should be, on the whole, tolerable in practice. There was no single part of the English criminal procedure, except that of the Grand Jury, which had not been transformed out of something else intended for an entirely different purpose. A great many of the apparent anomalies which still existed, though some had been lately removed, depended not on any deliberate policy, but on the archaic notions of justice which were universal many years ago, for instance, as to a prisoner not being examined in

political trials. He was a good deal examined in the Tudor period, but that was a period of bold innovations, some of which survived. He did not think the inability of a prisoner to say anything for himself depended upon any scruples about not making him incriminate himself. The old notion was that no man could be a witness in his own case, and the prisoner being a party could not give evidence. As to the Grand Jury he should be rather sorry to see it abolished. He was not aware it did any harm, and sometimes, though not often, it did some good. On the whole, the people who served on it rather liked it than not. At any rate, so he was told in the country. With regard to criminal appeals he should like to call attention to one matter of fact which had not been mentioned. Although Sir James Stephen was at one time a zealous advocate for a Court of Criminal Appeal, in his latest work, the revised edition of the "General View of the Criminal Laws of England," he said that on the whole his judicial experience had led him to change his mind and to think the disadvantages of instituting a regular Court of Appeal would be greater than the advantages. Of course, it was open to anybody to decide for himself whether Sir James Stephen's earlier or later opinion was preferable. We ought to pay a great deal more attention to Indian law and the working of Anglo-Indian legal institutions than we did, and he was glad Sir John Scott had had this opportunity of promoting that object.

Sir Courtenay P. Ilbert, K.C.S.I., said this paper was all the more interesting because it abounded in controversial points, on most of which he did not intend to touch, as he was even less qualified than the last speaker for dealing with the question of criminal procedure. Once or twice in early days he had defended, with limited success and for a limited fee, some prisoners at the assizes, and at a less distant date he appeared once in a police-court in connection with a watch case. He might add, it was his own watch. But he had never administered criminal justice, and had no special qualifications for discussing the greater number of the points dealt with. He would, therefore, content himself with putting in a modest protest against some of the propositions advanced, and suggesting that some of the reforms of English procedure advocated had too much Oriental flavour for his taste. With regard to codification he had considered the subject from the legislative point of view, and upon it he did not wish to say much; first, because it had been admirably dealt with already; and secondly, it did not possess now quite the same interest as it had some twenty years ago. He rather hesitated to criticise what Sir John Scott had said in its favour because he was an advocate of it himself within certain limits, but he thought a case would suffer if the arguments for it were overstated, and he was inclined to think that Sir John had put the case rather too high. He remembered the occasion on which Sir James Stephen's great draft code was brought before the House of Commons. It did not become law, not only because Parliament had not time to deal with it, but for other reasons. It was an open secret in the profession that although the measure was a very great one, and backed by high authority, yet, in order to be made completely satisfactory it would have required a good deal of careful discussion and correction. In the next place, the procedure code contained some rather bold innovations which probably an astute Parliamentary draftsman would have hidden away somewhere at the end of the Bill, but Sir James had a great contempt for the weaknesses of Parliament, and put them at the beginning, the consequence of which was that the discussion in Committee never got beyond those first controversial clauses. Another reason for the failure was that there was not much enthusiasm to support it. There were a great many people who doubted whether the case for codifying either criminal law or procedure was very strong. Sir John Scott had laid down two or three rather bold propositions about codification, in reply to which he should like to advance two others, which he believed to be substantially true. First, no English-speaking country, with very few exceptions, had codified its Civil Law. He had gone with considerable care through the legislation of everyone of our English colonies. One or two had codified with great advantage their Criminal Law; Canada led the way, and quite recently Queensland had produced an admirable code prepared by Chief Justice Sir Samuel Griffiths. There was a model penal code prepared by Mr. Justice Wright, a good many years ago, for the island of Jamaica, which had been adopted by two or three of the Crown colonies, but with these exceptions, he did not think any colonies had codified their penal law. A few of them had codified their criminal procedure. Some of the Eastern colonies or dependencies had adopted with modifications the Indian Code, but in the greater majority of them the criminal procedure was in much the same condition as in England. He did not think any of them had codified their Civil Law. The only exception he knew of was the Civil Code of Lower Canada, and that was a French-speaking country. Saving very few exceptions none of the United States had codified any important part of the law. His second proposition was that no country had ever codified its law simply for the purpose of improving its form; it had only done so under pressure of great practical needs and in order to meet practical necessities. As the Chairman had pointed out, the reason why France codified its law was because it was possessed of a strong desire to unify its law and have one law for the whole country. Italy and Germany had followed suit, and for precisely the same reasons. In both countries it was essential that there should be one law for the whole country. Unification could not be carried out without codification. Sir John Scott had told a story of an Indian criminal trial, and the reason why the

jury declined to convict a prisoner charged with murder. He would tell them an old circuit story, which he believed was authentic, though he would not specify the county or town in which it took place. A young man was on his trial for murdering an old woman, a very base and brutal murder. To ordinary persons the evidence seemed pretty clear, but the jury retired to deliberate and took some time. At last the foreman came back and asked the Judge how old might the old woman be. The Judge did not quite see the relevancy of the question, but thought there was no harm in supplying the information. It appeared that the old lady was 82. After having heard this the jury shortly came into court and pronounced the verdict of "Not guilty." One of the jurymen afterwards explained the reasons. He said, "Well, he was a fine young fellow, and us thought the old woman had lived about long enough." Some might draw from this story an inference unfavourable to the system of trial by jury, but he was far too conservative to do anything of the sort. The moral that he drew was that there was a great deal of human nature in man, and that human nature, even in the Indian juryman, was not substantially different from the human nature found in the English juryman.

Mr. James Sewell Neville said the question raised in the paper was a comparison between two systems of procedure; not the question of the propriety of codifying the Criminal Law. As he had practised both at the Bar in India and had been on the Bench in Calcutta, he might be allowed to give his opinion about the two systems. One point on which they differed was the abolition of the Grand Jury. In India no "true bill" had to be found before a case was submitted to Petty Jury. He thought the Grand Jury was useful in its day, but so far as he could see it had become useless now. It was simply an occasion of collecting the gentry in the county to ascertain something which was not necessary to be ascertained, namely, whether the prisoner should be put on his trial, for the magistrate committing was quite capable of deciding that point. The second point of difference was the non-necessity for unanimity in the jury, and he thought that change ought to be introduced so that if by accident a friend of the prisoner happened to be on the jury, or some one who belonged to the minority of faddists opposed to capital punishment, he should not be able to defeat the ends of justice by sticking out against the other eleven. Whether the verdict of six out of a jury of nine would be a sufficient majority was a different question. With regard to the facilities for appeal in criminal cases in India it must be understood that the criminal system in India was different in what was called the Mofussil and in the Presidency towns. In the latter the system was almost identical with the English, subject to certain changes made by the codes, and there was always a jury, but in the Mofussil there was no jury. Parties were there tried even on a charge of murder by a District Judge with two Assessors, and the Judge had power to convict even in spite of the opinion of the Assessors. A system of that sort required a large right of appeal. In the Presidency towns where there was a jury there was only an appeal on points of law. All who had practised in India were aware of the great advantages of the Penal Code which originated with Lord Macaulay, and was brought to perfection by Sir Barnes Peacock, Chief Justice of Calcutta. The decisions on that code were very few, and it was very seldom that any doubts as to its construction had arisen.

Mr. Manekshah J. Taleyarkhan* said that, having been for a long time engaged in the task of assisting in the administration of justice as a Pleader in the Bombay High Court, he was glad of the opportunity of making a few observations, but would only touch on two or three subjects among the many that had been referred to. It was a wonder to those accustomed to codes in India to see how we could get on smoothly without codes at all in England, and the only explanation was the great ability and learning of the Judges and of the Bar which assisted the Courts and the orderly habits of the people. As to the latter point he had been in England three days, and if the way in which a stranger was treated in the streets was any proof of orderly habits it was the most orderly nation he had ever heard of. In India codes were an absolute necessity because more than half the magistrates were not trained lawyers. In England it was a very different matter. One of the advantages of the absence of a code was the greater elasticity, but wherever law was elastic it must be administered by very able and conscientious Judges. One of the thorny subjects touched upon was the separation of judicial and executive functions on which a great discussion had been going on for some years, and would have to go on, but it must be settled after all. An interesting experiment was in progress in one of the Native States, Travancore, where the judicial functions had been separated from the administrative, and it was being watched with considerable interest. The Government of India was also taking effective steps to the same end by relieving the lower class of magistrates, revenue officials, from the duty of trying important criminal cases, and transferring them as far as possible to the higher magistrates. Sir John Scott had said that the natives of India regarded the High Court with superstitious veneration, and he might say that the Government almost did the same, as was proved by the fact that the Criminal Procedure Code left it absolutely to the High Court to revise every order and sentence passed by any magistrate. Not only was it perfectly true

* Mr. Taleyarkhan was unhappily killed in the railway accident at Slough on June 16th.

that the natives regarded the High Court as the palladium of their liberties, but they were very jealous whenever a Bill was introduced into the Legislative Council which had any tendency to curtail the powers of the High Court. He trusted that those powers would be always enlarged and never curtailed. He begged to add his testimony to that of the great native lawyer, Mr. Manomahan Ghose, that there never was a time during the last three or four centuries when justice was so well administered in India, and when the people were so well satisfied with it. They were dissatisfied about other matters, with the Executive for instance, but so far as the Judiciary were concerned they were absolutely satisfied both with the native and the higher European Judges who supervised the natives, and this was one of the greatest claims of England to the gratitude of Indians.

The CHAIRMAN then formally proposed a vote of thanks to Sir John Scott, which was carried unanimously.

Sir JOHN SCOTT said he was very glad to have excited a certain amount of discussion, which was the object of the paper, but he would only say that he still retained his own opinions.

The following correspondence has been received:—

MY DEAR SCOTT,

I was sorry to miss the opportunity of taking a part in the discussion raised on Thursday, the 24th, upon your interesting paper read before the Society of Arts on "English and Anglo-Indian Criminal Procedure." While agreeing in your conclusion that the separation of judicial and executive functions, as far as possible, is a desirable object, I should have liked to submit for your rejoinder and for the consideration of the Society a few criticisms as to your presentment of the case, and as to your arguments in defence of the existing system.

In presenting the case to an English audience, I think that it is expedient to reduce the controversy to its proper proportions. The broad principle of a thorough separation of judicial from executive action is so sound and well recognised that one naturally pauses before condemning one Viceroy after another, and one Ministry after another, for an alleged failure to carry it out in India. It is, therefore, well to remember that only one very small residuum of a great principle is at stake. The victory of the separatists has long since been won, and their dicta, which are so often misquoted now, were applied to a different state of affairs which has long since passed away. They condemned the union of the function of Judge and Collector, but now the Judicial and the executive are distinct in the whole domain of civil jurisdiction. Again, in the matter of criminal powers, such changes have been made that no officer who sets the police in motion should ever take the smallest part in the trial of the accused. No Collector-Magistrate ever need or I believe does, try a case in which he is interested which is more than can be said of our landlord Justice of the Peace in England. The entire separation of functions, which some advocate, affects, therefore, a very small fraction of semi-magisterial functions.

While the controversy affects a small parcel of magisterial powers it does not raise a practical question of reform. You quoted the testimonies of Mr Manomahan Ghose and of Sir Syed Ahmed, and you added your own tribute of admiration for the general administration of justice in India. Scandals, of course occur now and again in India as in England, but they are exceptions to prove the rule. No amelioration of justice is expected from the further separation of judicial and executive functions. Nor do the Indian people desire the reform, although it has long been advocated by the Congress. Every collector and assistant collector is constantly implored by accused and accusers to take up the trial of their cases. In Native States the separation has gone not nearly so far as in British India. In short the reform desired is theoretical rather than practical, and the objections to it, which have carried the day for so many years, demand full consideration.

You mention two objections, a financial, and what I may call a sentimental one. As to the financial I entirely agree with you that the cost would be heavy. For as your paper showed, our code of law represents Western not Eastern ideas, and some juries, composed of men who will not kill a flea, cannot be induced to hang a murderer. I recollect a case where a man convicted of breaking the arm of his girl wife, aged 13, was given 24 hours simple imprisonment by an experienced native magistrate, who explained his action to me by observing that the law ought not to allow a wife to proceed criminally against her husband. Therefore for many years to come you will have to employ a European magistrate in every district, and his status ought not to be less than that of the Judge or of the Collector. Then in every Taluka your Mamledar or Tahsildar will have to give up his magisterial functions, and the cost of the change will be enormous.

But when you state the administrative objection as one of "prestige," I venture to join issue with you. I would rather take the objection urged by Sir James Fitzjames Stephen against the separation of magisterial powers from the executive. He argued that the work of the executive officers would suffer from such a change, because they would lose the opportunity of learning the habits and feelings of the people which the trial of criminal cases affords. My own experience is that the best Collectors are the best magistrates, and *vice-versâ*. There is another aspect of the matter. Your executive officers advise on legislation, and you mention in your paper their large experience and knowledge of our codes. The Commissioners and higher officers of Government really qualify for their posts by the varied experience which they gain in the districts.

)eprive the executive of their magisterial work and you ·ill dilute the value of their counsel and experience. ᴌ further objection seems to me the inevitable con:ict of authority that would arise. The District Col-ɜctor and Magistrate must alone be responsible for he public safety and peace. Even the wise separation ıf civil judicial, and executive duties has its disadvan-ages in friction, as witness the Twidell and Penell ase, published in the *Gazette of India*, April 21, 900. What would happen if in a very hot and dis-ırderly district you had a judge, a collector, and a nagistrate all equal, all hot, and in conflict? We vant to govern India with a minimum of Europeans, ınd we have now reached the irreducible minimum. [f we can afford to pay for more they should be the 'our-sided men of many functions and experiences which we now have, and not men divided off into separate departments and narrowed responsibilities.

Yours sincerel,

W. Lee-Warner.

May 26, 1900.

My dear Lee-Warner,

I much regretted last Thursday that circumstances prevented you from giving your opinion on the separation of the judicial and executive functions in India. Your great experience and practical knowledge of the administration of that country makes your opinion of much value, and I am very glad you have now made time to put your views on paper.

If you see no objection, I should be obliged if you would send your note, with this, to the Secretary of the Indian Section of the Society of Arts for insertion in the *Journal.*

The progress towards complete separation of the two functions has, as you show, been very great, and the practical success of present arrangements is quite sufficient to make the adoption of complete separation of small urgency. But the tendency is that way, and what I still think the true theory will in time eventually, though gradually, prevail. There is much, however, to be said for "letting well alone." One word more. When I spoke of the possible bias of the revenue officer, I had no thought of a "personal" bias. I only thought of the tendency of most official minds that have not been judicially trained, to stand by their department, and try always to prove it right.

With many thanks for your note,

I am, my dear Lee-Warner,

Always sincerely yours,

J. Scott.

May 28, 1900.

Mr. H. M. Birdwood, C.S.I., LL.D., writes:— The members of the Society of Arts should be grateful to Sir John Scott for not allowing the Indian Chief Justice whom he consulted on the subject of his paper to turn him from his purpose; for, in the estimation of those who were present at the meeting of the 24th of May, he was eminently successful in his treatment of the whole subject, which he handled —if I may be permitted to say so—skilfully, with lightness of touch, good judgment, and a due sense of proportion. If I take advantage of the permission given by the Chairman to those of us who were unable to join in the discussion, in the short time available, to state our views in writing—for publication in the *Journal*—it is not in the hope that I can adduce fresh arguments on one side or the other of the controversial questions which were dealt with fully and ably by Sir John Scott, by the Chairman himself, and by other speakers, but only because I wish to tender my testimony on a few points to which our attention was specially directed before the close of the meeting. And, first, as regards codification, it seems to me (and I speak from an acquaintance with the Indian judicial system reaching back to 1859, when the first Indian Code of Civil Procedure became law) that, in India, the argument from convenience is so strong as to outweigh any other practical consideration. It is essential that the rules of procedure applicable to the several classes of cases coming before the ordinary Courts should be uniform throughout the territories subject to the jurisdiction of the High Courts; and it would be very difficult—indeed so difficult as to be practically impossible, in the present condition of the people and of the public administration, to secure such uniformity and all the public convenience that it implies, alike to Courts and pleaders and litigants, actual and possible, if the rules of Civil and Criminal procedure were not embodied in compendious Codes, arranged according to a sensible system, and readily understood. The Criminal Procedure Code (with which Sir John Scott was concerned) assumed its present comprehensive form in 1882, by a process of evolution from the Codes of 1861 and 1872, only after a long series of discussions in the Council of the Governor-General, dating in effect from 1860—the year in which Macaulay's famous Penal Code was enacted, which has well stood the test of time, having been rarely amended by subsequent laws—and after such deliberate consideration of the opinions of experts, as Sir James Stephen has described, and of numerous decisions of the several High Courts on questions arising under the two earlier Codes. It ensures, so far as any rules can ensure, that all proceedings in Criminal Courts shall be conducted with fairness and regularity, and it furnishes the requisite means for the rectification by the Superior Courts of irregular and illegal proceedings prejudicing the course of justice. Our judicial system in British India, as administered under the control of the High Courts, is thoroughly appreciated by the people. As regards the exercise of magisterial powers by Revenue officers, I would note that such a combination of executive and judicial functions is not opposed to the custom of the country or to popular sentiment, though it has been strongly objected to by some writers; nor is it productive of any such widespread evil as demands a subversion of the present system, or, indeed, of any evil results which cannot be remedied

under the Code. In India, the lowest territorial unit of administration is and always has been the village, the *patell* or head-man of which represents in his own person the cause of law and order, and, according to his degree, the magisterial and executive functions of government generally, though sometimes the duties may be shared with a Revenue *patell*. A collection of a certain number of villages constitutes a larger geographical and higher administrative area—known in the Bombay Presidency as a *taluka*—which is under the special charge of a native collector, or *mamlutdar*, as he is termed in Bombay, and he again is a magistrate, his head assistant being also generally a magistrate; and a certain number of *talukas* constitutes a collectorate or district, at the head of which is the Collector, who is practically the local Governor, and is invested with large powers for the maintenance of the public peace, through the agency of the District Superintendent of Police, for the collection of the public revenues, and for promoting in every conceivable manner the welfare of the people; and he again is a magistrate, and, as such, styled the District Magistrate. The assistants to the Collector are also magistrates. As administrative officers, the Collectors are controlled by the Commissioners, who are the rulers, under the immediate control of the local Governments, of divisions, consisting each of several collectorates. The Commissioners are not magistrates, nor do they discharge judicial functions in respect of any magisterial business in British India. The civil judges of the courts of first instance, who occupy in the judicial system a position corresponding to that of the native collectors in the revenue system, do not discharge any administrative functions, except as regards the establishments of the courts; nor do they exercise criminal jurisdiction, except only (so far as I know) in the Madras Presidency. The District Judges, who exercise original and appellate civil jurisdiction, are also the criminal Judges of the Courts of Session, and hear criminal appeals from the decisions of Magistrates of the First Class; and the Judges of the High Courts also exercise both civil and criminal jurisdiction. The Judges of the High Courts and District Courts have also control over judicial establishments. It is mainly to the exercise of magisterial power by the collectors and assistant-collectors, and by the mamlutdars or native collectors and their assistants that objection has been taken. Such a combination of functions would be regarded as anomalous in England; yet it commends itself to Indian indigenous sentiment, and it has secured efficient and economical administration. The people are accustomed to it, and are, I believe, satisfied that it works well on the whole. Cases of abuse of judicial power have undoubtedly occurred, but they are very rare indeed, and the people are shrewd enough to see that they occur sometimes in spite of, and not as a consequence of, existing arrangements, and that redress can be obtained in cases of real oppression—which, moreover, might occur under any system, however theoretically perfect. It is tolerably obvious that an Indian magistrate will be more efficient as a judicial officer if he has the knowledge which every revenue officer acquires, in the discharge of his duties in all parts of his districts, of the people and their ways of life; and that, in his capacity as a revenue officer, he is less likely to be led into any illegal or arbitrary course of action if he has acquired by education and actual judicial experience some respect for legal principles. The combination of judicial and executive functions in the person of any officer fitted by education and character for the duties of Indian administration seems to me, therefore, to be sound; and I should be sorry to see the authority of an Indian Collector weakened by his removal from the position of District Magistrate. Any such measure would not fail to be regarded by the Indian ryot as a disturbance of existing and valid guarantees for the maintenance of public order, which is the key-stone of our administrative system, on which depends the stability of our whole scheme of impartial government. I concur with Sir John Scott in approving of the provision of the Indian Code as to the examination of accused persons. It must be remembered that the object in view is not to obtain from an accused person evidence against himself, but to give him an opportunity—which is perfectly legitimate—of explaining any circumstances appearing in evidence against him. No authority is given to the Courts to cross-examine accused persons. The provision is intended, not as an instrument of torture, but in aid of fair and complete inquiry, and, therefore, in aid of justice. The accused person is not obliged to answer the questions put to him; but if he does not answer them, any inference may be drawn from his silence that may be considered just. With reference to Sir John Scott's remarks regarding juries outside the Presidency town, I would note that, in the Bombay Presidency, the jury system has been introduced into six Mofussil towns, in three at least of which it has worked quite satisfactorily. As regards appeals and revisions in criminal cases, I think that in India they are necessary in the interests of justice, to correct not only wrong convictions and excessive or else inadequate sentences, and to secure uniformity as far as may be desirable and possible in the administration of the codes, but also, with certain restrictions, to correct wrong acquittals. The idea of an appeal from an acquittal will find little favour from English judges and English counsel; but, under the Indian Code, the power of appeal in such cases is restricted to the local Governments. It must be exercised within six months; and as a matter of practice the Government would direct an appeal only on the advice of its law officers, and only on appreciable public grounds. The High Courts deal with such cases on certain recognised principles, which do not favour the undue growth of appeals of this nature. There would appear to be no sufficient reason for disallowing such appeals in British India.

4th June, 1900.

Sir Charles Cecil Stevens, K.C.S.I., writes:—
s I was engaged for by far the largest part of my) years' service in India in working the Criminal rocedure Code, and was a member of the Select ommittee of the Viceroy's Council which passed e code into law in its present condition, I wished contribute a little to the discussion on Sir John cott's paper, but time did not permit me to speak, id I accept the invitation of the President to contribute a few notes for publication in the Society's *ournal.* The audience owe much to Sir John cott, both for his own paper and for the important xpressions of opinion which it elicited from the istinguished speakers who followed him. The ıbject dealt with is very wide, and to condense an dequate treatment of it—such as would be unaniıously regarded as adequate—into the compass of a ngle lecture is a task which may well be deemed npossible. Perhaps there were present some, like ıyself, tolerably familiar with the Indian Criminal 'rocedure who would rather have heard more of that urrent in England. That Sir John Scott found it ıore convenient to base his paper on the Indian Code seemed to me to point to the superior ystem and handiness of that code. Much was aid at the meeting on the subject of codification generally; possibly the advantage of codes vas stated too broadly in the paper; and the President's observations in limitation were very mportant. No one, however, so far as I am aware, ıas suggested the codification of the substantive Civil Law in India; and such a suggestion, if made, may e cast aside at once as wholly impracticable. The nanner in which the several systems of Civil Law in vogue in India are dependent upon, and intimately connected with, the religion of the corresponding sections of the community would be decisive on this question. Mohammedan law could not blend with Hindu law; neither could give way to the other; and no compromise is possible. Whether each system itself could, or could not, be codified with advantage is another question, but not one which is for present consideration. The Code of Civil Procedure, I may say in passing, has amply justified itself by its practical utility. As to the advantage of codifying the Criminal Law, both substantive and adjective (or perhaps rather "instrumental,") I am entirely in agreement with Sir John Scott. Those who object to the codes as rigid, I suppose, object to them as not allowing sufficient elasticity in their interpretation, or as being difficult to alter. The former of these objections seems to me to be almost a recommendation. Certainty is more desirable than elasticity—especially in a country in which legislation is not difficult. India is such a country. There are no party politics; there are few long, heated, irrelevant discussions; if a law is found to be defective or inconvenient, the process of legislative amendment is simple, and there need be no excessive delay. As a matter of fact, the Indian Penal Code has admirably borne the test of 40 years' actual experience; the alterations and additions which have been found requisite are few, and for the most part unimportant, compared with the bulk of the work. Although the present Criminal Procedure Code is usually spoken of as Sir James Fitzjames Stephen's, it was not the first code enacted to answer the same purpose. Act XXV. of 1861 codified the law, made it definite, and brought it within a narrow compass. Sir James Fitzjames Stephen, in 1872, adopted this as a basis, rearranged it, and added much more than he altered. It was to be expected that the first Code of Criminal Procedure should require earlier and more extensive amendment than the substantive Criminal Law, the general principles of which are stable. But the changes subsequent to 1872 have not been numerous or more important than experience and altered conditions have shown to be necessary. In making the last revision the Select Committee and the Legislative Council, under the able guidance of the Legal Member, Mr. Chalmers, were anxious to disturb the law as little as possible, so as to avoid causing needless inconvenience to the public and to the Courts. And I do not anticipate that much change will be found necessary in the future. It was said in the course of the discussion that there is no great difficulty in the way of a person who wishes to acquaint himself with the accepted English Criminal Law, since text-books and compilations are to be had. I venture to think that the Indian Codes have the advantage of being compact, intelligible, certain, and authoritative, besides being cheap and very easily procurable. And as a result I am certain that an ordinary Indian gentleman is far better acquainted with both codes than most educated Englishmen are with the Criminal Law of their country. The officials who, either as members of the Councils, or as advisers and writers of reports, assist in Indian legislation, could desire no more ample and generous testimony to their goodwill and efficiency than that given by Sir James Fitzjames Stephen in the passage quoted by the reader of the paper. In the present day these praises would be shared with the Press, with the various semi-official and private Associations, and with the numerous individuals who place their knowledge and experience at the disposal of the Government and the Council. When an important legislative measure of a general nature is undertaken, every endeavour is made to obtain unofficial as well as official opinions; and all the papers thus collected are circulated, not only to the Select Committee, but to all the members of the Legislative Council. If the changes made by a Select Committee are very important, the revised Bill is published before being passed into law. Whether greater efficiency can be attained under a system of Parliamentary legislation may perhaps be doubted; under the conditions of India I can suggest no improvement.

I will now venture to submit a few criticisms on the elaborate details of the paper. The remark regarding "the series of definitions in the Indian

Code which are of the greatest use to the Judge and practitioner, but would hardly be of the same use to the distinguished administrators of justice in England" appears to me to be more applicable to the definitions of the Indian Penal Code than to those of the Procedure Code. For the latter merely explain the senses in which certain words and phrases are used in the Code itself, while the former have reference to principles and legal distinctions. But even in this case I can scarcely agree, for I think that the reader of the paper had in his mind the learned Judges of the highest courts; if we take into account the great body of Magistrates, of whom most have had little or no legal training, it seems that clear definitions would be most useful to them. Perhaps those who are not familiar with Criminal Procedure in India would scarcely gather from the paper that there are important differences between some of the provisions relating to the Presidency towns and the corresponding provisions applicable to the Mofussil (or interior), which contains the great bulk of the people. For instance, the abolition of the Grand Juries which is mentioned affected only the former comparatively small area and population. There were no Grand Juries in the Mofussil. Again it might possibly be gathered from the paper that the "Presidency Magistrates" form a link in the chain of the ordinary "Judicial Hierarchy." But these are a special class of magistrates ordained for the Presidency towns, and they are subject to certain special rules, the effect of which is to give them higher powers than those which Honorary Magistrates can exercise in the Mofussil. The Presidency Criminal Courts differ in their origin and history from those of the country at large. The system of village magistrates, described by Sir John Scott, is, I imagine, peculiar to Bombay, and must rest on some authority outside the Criminal Procedure Code; it does not exist in Bengal. The observation that "the unpaid Magistracy of England finds some slight equivalent in the Justices of the Peace, but they play a very small part in the administration of justice" is not applicable to Bengal, even if it is true of Bombay in the present day. In Calcutta there are at present upwards of 80 unpaid Presidency Magistrates and a few Justices of the Peace who are not Presidency Magistrates. These do a very appreciable proportion of the less important work, the more serious cases being taken by the salaried Magistrates, who are either barristers or Members of the Imperial or Provincial Civil Services. In the Mofussil the employment of Honorary Magistrates has in later years been greatly developed. There are upwards of 2,000 of them in Bengal, and there is no district without any, while in some they are very numerous. A few are magistrates of the first class, and can pass sentences of imprisonment up to two years; many more are of the second class, and can imprison for six months; the greatest number are of the third class. Some sit alone for the trial of cases; but, for the most part, they are associated in Benches, which may be vested with such powers as the local Government directs, or, in the absence of special directions, exercise the powers of the highest magistrate present. The Honorary Magistrates are often dilatory and wanting in punctuality, and sometimes there is a tendency to excessive leniency. These defects will be lessened in time, I think; but even now a substantial amount of help is given to the criminal administration.

On the question of the separation of the judicial from the executive functions of the District Magistrate, I am of opinion that the balance of arguments is against a change—at any rate, under present conditions or in the near future. In Bengal a district generally contains some two millions—often more—of inhabitants; a man capable of supervising either the Magistrates or the executive work must possess high qualifications and be highly paid. The salaries now given are certainly not too high; the career of an Indian Civilian appears to be less tempting in the present day than the Home Civil Service. The Government cannot afford to double the number of such officers. A District Officer is constantly expected to "use his influence" in matters outside his official functions; and even in work falling within them this influence is often effective and beneficial. It is obvious that to lessen his powers must lower his influence and prestige. The practical objections to the present system seems to me to be exaggerated. The chief magistrate of a district tries very few original cases himself; in a heavy district he cannot possibly try many. He hears appeals from the lower classes of magistrates. His interference is mainly directed to ensuring promptitude and regularity in the disposal of cases, and a suitable division of the work. He is available to advise subordinate magistrates if they require advice. On the other hand, his knowledge of the judicial work enables him to watch the police, very much to the advantage of that department and of the public. In the Presidency towns the case is different; there is no necessity for a predominant district official representing the Government, and the police have for their departmental head an officer of special ability and experience. At the same time, my own opinion is that the subordinate police in Calcutta have quite as much power as those in the Mofussil. I am scarcely prepared even to admit that the separation of the judicial and executive functions in the Mofussil is a "counsel of perfection." I think it unsuitable to present circumstances. Men are not perfect, and it is quite possible that instances of indiscretion and, perhaps, scandal may be quoted against me; but these are not necessary or unavoidable, and they are few in comparison of the advantages of the present system. When they do occur, the ample powers of supervision possessed by the High Court provide an effective remedy. In the matter of the examination of accused persons, the Indian law appears to me decidedly superior to the English. In the former no oath or affirmative is administered, and it is the Judge or Magistrate who interrogates; there is nothing

of an inquisitorial nature. The modern English law gives the accused the option of being silent or of being put on oath and cross-examined with such severity as the opposing lawyer may deem appropriate. This alternative seems scarcely fair to the accused, and is likely to lead to much perjury. The reader of the paper remarks of the system of trial by jury: "Outside the Presidency towns it is hardly applicable, and is, I think I may say, never applied." Doubtless he was speaking of his own experience, not, I think, very recent, in Bombay. The observation would not be correct if applied to Bengal. The Code lays down that in trials before the High Court on its original side there must, and in cases transferred to it, there may, at its discretion, be a jury which shall consist of nine persons. As to the Mofussil, the Government may direct that the trial of all offences, or of any class of offences, before a Sessions Judge shall be by a jury consisting of such an uneven number, not less than three or more than nine, as the Government may order either for the district generally or for any class of offences. For many years there have been trials by jury in several districts of Bengal where a sufficient number of persons to afford a suitable jury list could be found. There are classes of cases which it has not been deemed expedient to make over to juries; and in those which have been made over there have been varying degrees of success. In those trials into which the element of sentiment enters, the system is not altogether efficient; in others, I think, the general opinion is in its favour; for its success, taste, and judgment are required in the presiding officer: and it is understood that officers possessing these qualities are specially selected to be Judges in the jury districts of Bengal. The murder case mentioned by Sir John Scott, which apparently was tried in the Bombay High Court, seems to support a very common belief that in murder cases a dread of being parties to capital punishment has sometimes much influence over the minds of jurymen.

The reader of the paper has entered fully into the questions of appeal and supervision. Some of the details under the former head require, I think, a little modification. All convictions by Magistrates of the second and third classes are open to appeal; convictions in petty cases by first class Magistrates and Sessions Judges are not. The statement that there is no appeal in cases where the accused pleads guilty is too broad; there is an appeal if the Magistrate be of the second or third class; but from an order of a Sessions Judge, a Magistrate of the first class, or a Presidency Magistrate, there is no appeal except as to the legality or extent of the sentence. There is an appeal against a sentence of imprisonment in default of payment of a fine if the original sentence is one of imprisonment as well as a fine. The elaborate system of appeals is not without some disadvantages; but in considering these it should be borne in mind that a large proportion of the appeals is summarily dismissed. The Appellate Court peruses a copy of the judgments, and hears the appellant; if the appellant cannot show substantial reasons for questioning the justice of the order his appeal is thrown out at once. With perfect Judges and Magistrates there need be no appeals; till such functionaries are to be discovered an efficient system of revision and appeal appears to be highly desirable. I am in full agreement with Sir John Scott as to the immense value of the High Courts' supervision. There is, I may say, a good deal of supervision other than that provided for in the Code. The magistrate of a subdivision periodically examines the registers and records of his own Court and of his subordinates. The magistrate of a district similarly inspects the work of all his magisterial subordinates. In Bengal the Commissioner, who is charged with the supervision of several districts, makes similar inspections; but, as he is not a judicial officer and has no acknowledged powers in this Department, he forwards his notes to the High Court for orders. These several inspections have for their object to ensure that judicial proceedings shall be prompt and regular, that parties and witnesses shall not be put to needless trouble, and that any gross incapacity or misconduct shall be exposed. The Government circulates reports of important rulings of the High Courts for the information of the officers. The result of all this system of inspection and supervision is that, without interference with judicial independence, the administration of Criminal Justice is rendered far more efficient than it otherwise would be. So far as I can judge, with (I must confess) very limited experience and opportunity of forming a comparison, there is more uniformity in Bengal than there is in England, in the sentences passed. I do not, of course, mean that the sentences for the same nominal offences vary within narrow limits; but I think that similar offences committed under similar circumstances, are punished with more uniformity, and with less regard to the idiosyncrasies of the individual Court.

I had thought of briefly discussing some of the preventive sections of the Code, more particularly those relating to the prevention of breaches of the peace in the assertion of claims to immovable property, and the new provision affecting persons disseminating seditious matter; the latter was the cause of much discussion. But it is not possible to deal with all that is of interest in the Code, and I fear that this note has already exceeded reasonable limits.

Mr. T. Durant Beighton writes:—Sir John Scott's varied experiences have enabled him to give us an excellent comparative analysis of the differences between English and Indian Criminal Procedure. Not the least distinguished of the offices held by him was that of Judicial Adviser to the Egyptian Government. Many of us, no doubt, heard last year the interesting account which he gave of his work in Egypt, and though rather late in the day, I should

like to congratulate him on the completion of the reforms, which he told me, when I made his acquaintance in 1896, he was endeavouring to carry out. Indian Procedure was first codified in 1861; but this codification was looked upon as an experiment, and was not by any means intended to form a stereotyped body of rules. In almost every successive year since that date various clauses have been modified by short amending Acts, and the entire Code was re-modelled, with important alterations, in 1872, 1882, and 1892, and I believe another edition, with further modifications, is contemplated. So far, therefore, from possessing the rigidity which ordinarily attaches to a C.P.C., which is published once for all, we have in the Indian C.P. all the flexibility which is gained by a system founded on Case Law. We have in fact the legislative machinery constantly re-adapted to suit the exigences of administration and excisions and additions made in directions which experience shows to be advisable. I am sure that my friend, the late Mr. Manomahan Ghose, was right in saying that the people of Bengal have learnt to appreciate the blessing of a pure administration of justice. I would even go further. I am not sure that it is not almost the only result of our Indian administration, which they regard as an unmixed boon. Possibly when Macaulay's New Zealander visits India in the dim and distant future, tattered editions of the various codes of Criminal Procedure will with soda-water bottles and railway sleepers be the only outward and visible sign then extant of our Empire in the East. But there is one thing which is as necessary to the proper administration of justice as purity, and that is equality and certainty. Equality as regards rich and poor, influential as well as insignificant members of society, and certainty in the sense that punishment shall be meted out for crimes of one class as invariably as for others. This brings me to a subject on which I wish to make a few remarks—the consideration of the system of trial by jury in Bengal. Sir John Scott is evidently unaware of the extent to which this system prevails in the country. He seems to think it is hardly applicable outside the Presidency towns; this is a serious misapprehension. The Code of 1861 contained a provision by which the Governor or Lieutenant-Governor of any Presidency was empowered to notify that the trial of any particular offence, triable by the Court of the Sessions, should be by jury in any district under his administration. In the Province of Bengal trial by jury for serious offences against person and property, for false evidence, for offences against the public tranquillity, and offences connected with trade and property marks, and one or two other classes of offences was thus introduced into seven districts of Bengal. This step was taken avowedly as an experiment, and it is, in my opinion and that of many competent authorities, an experiment which has worked very badly as regards that class of offences which are, in my opinion, the most important—those which affect the security of life—the offences of murder and culpable homicide, *i.e.*, the various forms of manslaughter. This is obviously not the time for an exhaustive discussion of the subject, which must be reserved for a future occasion, but I should like to make a few observations upon the great diversity between trial by jury, as it prevails in this country, and the hybrid and extraordinary system which now exists in India under that name. It is utterly unsuited for the trial of offences in India involving human life. When first introduced in 1861 it was enacted that the verdicts of juries should be final. Experience showed, however, that perverse verdicts were so common in the class of cases to which I have alluded, that finality was done away with in the Code of 1872, and has never re-appeared in the Statute-book. A Section was introduced, empowering Sessions Judges, if they thought the verdicts of juries were utterly unreasonable (I am using my own language, and not that of the code), to refuse to accept them, and to refer the case to the High Court, which was authorised to draw its own conclusion from the facts in evidence, to find the accused guilty or not guilty, and to pass such sentence as they thought proper. In other respects also, the principles of the system are fundamentally different from those which exist in England. Not only has it no finality, but there is no provision for the seclusion of jurors, and, thirdly, it is not adopted in cases of offences against the State, or offences committed by public servants in the execution of their duty—the very offence with regard to which its introduction from an English standpoint would have been most essential. Large sections of Indian society, such as the Vaishnavs, are utterly opposed to the shedding of human blood, and are conscientiously unable to find a verdict of guilty in a murder case, however clear the evidence of guilt may be. The number of persons qualified by education and respectability to be put upon the jury list is so small in the districts of Bengal, where it is in force, that it is often impossible to empanel an impartial jury. It is an undoubted fact, and one that is vouched for by unimpeachable evidence, that in the intervals of protracted trials—and all trials where rich and influential criminals are concerned are protracted—jurors are frequently approached and influenced by relations and friends of the accused to give a corrupt verdict of acquittal. Respectable and well-to-do members of society enjoy an almost complete immunity when tried in jury districts, however strong the evidence. I could give numbers of illustrations to prove my point, drawn from all parts of Bengal. I will only mention one which I tried myself. A sepoy, in the regiment quartered at Dinapur, shot a native officer dead in open daylight before the whole regiment, and proceeded to barricade himself in a hut, threatening death to any one who approached him. He was arrested with great difficulty, but was acquitted by the jury empanelled to hear the case. The only comment I need make upon this is to add that the accused was a Brahmin.

I think I have some right to express an opinion

on this subject, for I am sure I shall receive the deep commiseration of every one who has served in India, when I state that I believe I have conducted more trials by jury than any one else that ever lived in Bengal. I have been employed in six out of the seven districts where jury trials are held. In fact, until I acted as Legal Remembrancer, I served in scarcely any other class of district. I need not say that I have at various times, in common with many others, used all the influence I possessed in reports to Government and to the High Court, as well as in the public Press, to denounce the evils of the system. In 1889 I published an exhaustive examination of the history of trial by jury in India with a fairly complete analysis of the results. This article was much discussed and excited a good deal of interest in the subject. In the year 1893 action was at last taken by the Government, and Sir Charles Elliott, who was then Lieutenant-Governor of Bengal, in the exercise of his powers under the section already referred to, issued a notification directing that trial by jury should be abolished in the seven districts of Bengal, in which it had been in force for the trial of murder and culpable homicide cases. The notification further provided for the first time for the trial of offences against marriage by jury—a recommendation which I had made in my review of the jury system for reasons into which I cannot now enter. I think Sir Charles Elliott would now be the first to admit that his action was a mistake. To do away wholesale with a form of trial for homicide cases which had been in force more than 30 years gave a great shock to that section of native public opinion, which is the noisiest and, therefore, the most influential. Had the same reform been accomplished piece-meal and by degrees, no agitation would have been aroused. The abolition of this form of trial for murder cases might, for instance, have been accomplished for the Patna district, immediately after the indignation aroused by the acquittal of the sepoy above referred to without exciting hostile comment. As it was, many will recollect the terrific outburst of hostile criticisms from the entire native Press which swept over the country. Floods of abuse were poured upon the devoted heads of the Lieutenant-Governor, his Chief Secretary, and upon myself. A political complexion was speedily given to the notification. The Liberal party, who were at that time in power in England, became alarmed by the misrepresentations which reached them of the unanimity of adverse popular opinion which had assailed Sir Charles Elliott's action, and the notification had ultimately to be withdrawn. For my own part, I believe there never was an agitation which was more hollow and fictitious, or which was less representative of true native opinion. The entire native Press was in fact controlled by the small body of educated native barristers and pleaders in Calcutta, who pose as the champions of reform, and of the rapid assimilation of English methods of administration in their own country. But, although I regret the sweeping nature of the notification, it has after all done its work, for so much public attention has been concentrated on the admitted evils of the system, that any serious extension has been practically rendered impossible in our generation.

There is one other alteration in the law which was introduced by the Code of 1872, which has not retained its place in the Statute-book, on which Sir John Scott has not touched. The Code of 1872 gave power to the Superior Courts to enhance sentences on appeal. This provision was, in my humble opinion, a very satisfactory one. It had the double effect of checking frivolous appeals, and of enabling Judges to correct the anomalies in sentences such as those with which the readers of *Truth* are familiar. Our native Magistrates, however, are by no means liable to that class of errors which Mr. Labouchere is constantly showing up for our delectation and amusement. Crimes against the person are punished with Draconian severity, but a sentence of a fine of 8s. for bringing a false case or for perjury errs perhaps on the side of leniency. Housebreaking by night, with intent to commit an offence, is somewhat inadequately punished by a sentence of one month's imprisonment. Perhaps the most extraordinary case that ever came before me was a sentence of a small fine imposed on a man who was found guilty of attempting to wreck an express train. All these anomalies could be redressed by the powers conferred on Appellate Courts by the Code of 1872, and I regret it has been withdrawn in later codes.

Miscellaneous.

TILES AND MOSAICS IN VENICE.

The tile and mosaic industries of Venice and the surrounding region are not carried on by the same persons or in the same manner, and in any study of their manufacture they must therefore be considered separately. It should also be borne in mind that while Venice enjoys a high and deserved reputation for her arts of mural and pavement decoration, that reputation, according to the United States Consul at Venice, is for the most part of the past. It is true that the mosaics of modern Venice are to be found now in nearly every city of importance, but this is largely due to the traditions of Venetian glass making. There are in Venice two important houses concerned with decoration by mosaic—the Società Musiva Veneziana and the Compagnia Venezia Murano. Of these, the former devotes itself exclusively to decoration. The material employed is the Venetian vitreous mosaic obtained by the Società Musiva Veneziana from the glass factories of Murano. Thus the company has nothing to do with the manufacture of the mosaic itself, and does not deal in mosaics as commercial products. It may not be irrelevant to note a few of the more important

buildings decorated by the Società Musiva Veneziana. Among them may be named the Duomo of Florence (restored facade); the church of Santa Maria Ausiliatrice of Turin; the church of Santa Maria Immaculata at Genoa; the tomb of Pius IX. at Rome; the Jewish synagogues of Milan, Turin, and Florence; the Church of Notre Dame de la Garde at Marseilles; the Cathedral of St. Vladimir at Kief; the Church of the Resurrection at St. Petersburg; the monument of Alexander II. at Moscow; and the Russian churches in Vienna and Jerusalem. The Compagnia Venezia-Murano differs from the Società Musiva Veneziana in that it has its own glass furnaces at Murano, and conducts the mosaic business as a department of glass manufacture. The mention of these two houses by no means exhausts the Venetian producers of, and decorators in, mosaics, but no other firm works on a parallel scale. The many glass factories manufacture mosaics as a side product. The industry is not one to be considered by itself—hardly even in the case of the Compagnia Venezia-Murano—and among the smaller establishments is of the most incidental importance. As to buildings noteworthy for their polychrome decoration, that is a subject rather to be studied from the literature of architecture, for in spite of the wide admiration for Venetian mosaics, not one modern edifice in Venice bears that decoration, with the exception of the headquarters on the Grand Canal of the Compagnia Venezia-Murano, if a restored Renaissance palace may by courtesy be called modern. The peculiar situation of Venice, however, renders the erection of modern buildings more difficult and more undesirable than in other cities, which may account for the neglect by the modern Venetians of the polychrome decoration so much affected by their ancestors. There cannot be said to exist in Venice an industry for the manufacture of marble mosaics for pavements. There is desultory activity in this direction, occasioned by the necessity of repairing the floors of St. Mark's, and other buildings notable for their decoration in this respect, but nothing in the way of an organised business. The manufacture of tiles is something quite apart from that of mosaics, and in the city of Venice is unknown. There is a tile factory in the district of Veneto, and one in the city of Treviso, which makes tiles by a secret process from clay found in the region of Treviso. The qualities claimed for this tile are resistance to friction, extremes of temperature and chemical action. It is also very light and less expensive than marble flooring. In appearance it is glazed and coloured throughout with plain tints. The tiles are intended for any kind of interior or exterior pavement, but on account of their pleasing appearance are excellently adapted for simple mural application. The highly-decorated tile is not produced in Venice. A number of small establishments manufacture paving tiles of different cements or clays. The supply, however, is purely for local use and exceedingly limited, while the methods of production are altogether primitive. In general it may be said that the cost of production both of tiles and mosaics is small. The clays and cements for the tiles are obtained from the neighbouring districts, the "smalts" of mosaic come from the adjacent glass factories, and labour is cheap. In the Venice glass and mosaic factories woman and child labour are largely employed, and the working day is about eleven hours.

CABINET-MAKING SCHOOLS IN GERMANY.

Consular reports of recent years contains a great deal of information on the subject of technical and industrial schools in Europe, and they clearly show that Germany easily takes the lead in the matter, by annually appropriating large sums of money for instruction in almost every art and industry. It is generally recognised that the commercial progress throughout the country depends largely upon the condition of technical education. Besides the many schools for agriculture and commerce, the system of special schools for other purposes is wonderfully completed. The tailors, the painters, the shoe-makers, the bakers, the smiths, the brewers, the butchers—each trade has its schools for theoretical and practical training. The United States Consul at Bremen, states in his last report that he recently discovered at Magdeburg a school that roused his interest to an unusual degree. Though familiar with educational work in Germany, and also with technical schools, he says that he has never yet seen such an institution. This school was found by a citizen of Magdeburg—a plain mechanic, a cabinet-maker, but a genius at his trade. After having been prosperous in business, he wished to aid young men apprenticed to the trade of furniture making in his native town. Under Prussian laws youths who, after having passed through the public schools intend to learn a trade, are required to continue attending a school for some nights during the week and for two hours on Sunday. Such schools are called "Fortbildungs-Schulen," a term signifying a school where the education is to be continued. The founder of the cabinet-making school had, through his own long experience become convinced that such schools could not accomplish this purpose satisfactorily, because boys at the age of from 14 to 17, after being hard at work all day long, cannot be in a condition, either physically or mentally, to attend school for hours with any benefit to themselves. He therefore conceived the idea of establishing the school referred to. To accomplish his object, however, he needed the assistance of the Magdeburg union in the line of cabinet-making, sculpturing, and wood-carving, and their co-operation was granted to him to the fullest extent. All the head mechanics of the cabinet-makers, though most of them are men without any means, and therefore can ill afford to lose their time, agreed to send each of their apprentices to

this school for a whole forenoon in every week, and also to take turns in assisting in the work of teaching. Consul Diederich says:—"I believe it is impossible to conceive of anything more practical than the teaching in these classes of which there are three, as it is a three years' course. No question is put, no fact explained, no definition given, and no drawing made but has some bearing upon either the materials or the tools, or the purposes of the combined trades mentioned above. Great stress is laid upon freehand drawing, as this is to give the young men not only all the technical knowledge needed, but also to train the eye and the mind in designing every part of the various styles of furniture as well as artistic decorations in wood-carving and inlaid woodwork." The attention of the Government, both municipal and national, is now being called to the importance of this work, and it is hoped that the institution will soon be placed on a sounder financial basis. It is anticipated that this school, if properly supported and wisely conducted, will, in course of time, build up on Magdeburg an industry which will give employment to hundreds of artisans and mechanics, and bring renown to the city for its manufacture of fine and artistic furniture, as Dresden is noted for its fine chinaware, Munich for its works of art, and Leipzig for its great book mart.

AUSTRALIAN IRRIGATION FARMS.

Some irrigation experiments of a remarkable character are at present being conducted in New South Wales. As is generally known, there is an immense inland region, used exclusively for pastoral purposes, embracing an area of several thousand square miles, and graphically described as a waterless country, the rainfall being slight, and the water supply extremely precarious. Yet it was not until within the last few years that it was definitely shown that abundance of water could be obtained, not only from the cretaceous formation, but also from other rocks underlying the soil in this part of the colony. Artesian boring in New South Wales commenced in 1879, in which year operations were begun at Kallara, a station lying between Bourke and Wilcannia. The supply was tapped at a depth of 140 feet, and the effluent water rose to a height of 26 feet. In 1884 the colonial Department of Mines put down its first bore in search of water, a small supply of which was reached at 89 feet. Since then much work has been done, both by the Government and by private enterprise. On the 30th November, 1899, there were 73 completed Government bores, while 12 were in progress, and contracts had been let for others. Of those completed, there are 48 flowing, yielding a supply of approximately 29,000,000 gallons per diem, and 16 from which a supply of 750,000 gallons per diem can be pumped; but in the remaining 8 bores the search for water suitable for drinking purposes has been unsuccessful. The deepest bore sunk in the colony is that at Dolgelly, on the road from Moree to Boggabilla, which is down 4,086 feet, yielding a flow of 745,200 gallons per diem. The next in depth is the Bancanya bore on the Silverton-Cobham road, being 3,615 feet deep. The largest flow has been obtained at the Toolora bore, on the road from Walgett to Coonamble, which yields approximately 3,000,000 gallons per diem. The water from the Government bores, over and above that required for travelling stock and domestic use, is being used for irrigation purposes, and much has already been accomplished in this direction. At the Pera bore, 8 miles from Bourke, on the Wanaaring road, an area of 68¾ acres has been reserved for an experimental farm. The remainder of the land has been cut up into 20-acre blocks, all of which have been let under the homestead selection provisions of the Crown Lands Act of 1895.

Should future results realise the anticipations formed by those who have carefully studied the question, it is possible that the vast expanse of treeless, waterless country, at present given up to sheep, and which is a source of heavy loss to pastoralists during prolonged periods of drought, may become studded with richly fertile spots.

The system of soil aeration now adopted is said to have proved successful in every respect, and where, only a few years ago, there was nothing but dry, burnt-up country, may now be found beautiful gardens, filled with the choicest flowers, growing in luxuriant profusion, and orchards filled with healthy trees giving the rich promise of future abundant crops. But there have been varying results on the irrigation farms. Several have been successful, and others only partially so. This, however, has been occasioned largely by the character of the tenants. Those possessing real agricultural experience and willing to turn it to the best account, have found irrigation-farming a remunerative enterprise.

TRIPOLI DATES.

The number of date palms in the vilayet of Tripoli, North Africa, is computed at 2,000,000, and the date palm is the most important of all trees, all its component parts serving usefully in some way or another; the fruit for food, the leaves for mats and hut coverings, the wood for building and fuel, the fibre for baskets and ropes, the juice for drinking, and, finally, the stones made into a paste are given as food to animals. A certain quantity of date stones is exported to Italy to adulterate coffee. Consul-General Jago says that date paste also forms an article of export to Egypt and Turkey. The date enters largely into the food of the people, especially during poor cereal harvests, when its price is governed by that of barley. The tribes of the Fezzan consume large quantities of the Tripoli dates as their principal food, and every autumn caravans arrive from the interior, especially at Misurata, for the purposes of purchase. Animals are fed on them in the oases of the interior. A

large consumption of logbi, or palm wine, the juice of the tree, takes place in the country among all classes, religious prejudices not applying to it as an intoxicant; the season is from May to October. An incision is made near the top of the tree, and the sap allowed to flow into an earthenware jar, which is attached and changed twice a day. The flow continues nearly three months, but not always in the same quantity. A good tree produces logbi to the value of two shillings to two shillings and sixpence per day, but its extraction causes it to produce no fruit for the next two or three years. The consumption, however, is great, and little labour is required. The total annual value is about £3,200, the tax being twenty shillings per tree excised. When taken fresh from the tree it resembles milk, and has a sweet taste, but later on becomes sour. A small quantity of spirit, called "bokha," is distilled from the date, and is consumed locally. It is an intoxicant, and somewhat resembles arrack. Efforts to export dates to Europe for distilling purposes have failed owing to heavy import duties. The export of dates to Bengazi, Egypt, and Turkey varies between £700 and £2,000, according to good or bad seasons, and chiefly from Zleiten, Misurata, and Tuarga. Plantations are rare, except in those parts which are exempt from taxation.

Correspondence.

PRACTICE OF LETTERING.

There is no doubt that letters were gradually evolved, their shapes being due not so much to the material on which they were inscribed, as the instruments adopted. In the first place the pen played a premier part, as we can see in the Chinese and the Hebrew, where the up and down strokes are so visible; and after that the cuneiform characters of the Assyrians, being but a series of deep cuts—all angles. Then came the Roman with its inscriptions, all in capitals, with its V's in the place of U's, a full point intervening between each word, often displaying the seriff. That met its consummation in our modern type, to which we have added a "lower case," founded on a round-hand script.

The Gothic, or "black letter," again, is a purely hand-wrought character, being an imitation of monastic writing.

Of our letters in daily use, capitals founded on the Roman, 14 are due to chisel cuts, and 11 to some more mobile instrument; thus it might be well to increase our angular capitals and reduce our rounded ones, or *vice versâ*. As an instance of this I would note that some 25 years since I put upon the heading of the weekly *Graphic* a round E, and upon a monument another form, both forms being now largely adopted, and indiscriminately, though one was made for paper printing, and the other for incision upon marble. JOHN LEIGHTON.

Obituary.

MR. T. B. KIRKHAM.—Mr. Thomas Brown Kirkham, barrister-at-law, whose death occurred recently at Eastbourne, had been a member of the Society since 1879, and took much interest in the work of the Indian Section. He first went to India in 1862, and commenced his career in the Bombay Education Department as headmaster of the Poona High School. In 1866 he became Principal of the Elphinstone High School in Bombay, and in 1873 he was appointed Professor of English Literature in the Elphinstone College. Five years later, Mr. Kirkham became Educational Inspector in the Central Division. In 1886 he was placed on special duty in England, for the purpose of inquiring into the methods of technical education followed in this country, and the immediate result of his investigations was a report for which he received the thanks of Government. From July, 1895, until he finally left India, he was a member of the Bombay Legislative Council.

General Notes.

TRAMWAYS EXHIBITION, 1900.—On June 22nd, a Tramways and Light Railways Exhibition was opened at the Agricultural-hall by Mr. W. H. Dickinson, Chairman of the London County Council. This is the first exhibition of the kind that has been held in London, and the number of exhibits extend to over one hundred.

COLOUR PRINTING.—The Printing Arts Company have published an edition of Rudyard Kipling's "Absent-Minded Beggar," with coloured illustrations, printed at the Orloff Press, and the sixteen pages have passed through the press only once for each side of the sheet. The colour effect in this little book is obtained from blue, yellow, red, and black, the black giving the type as well as the outline to the drawings. The speed of the Orloff press printing all colours at once is said to be equal to that of any first-class press for printing one colour. The average number of separate colour printings which have to be superposed on the paper to obtain a full chromo-lithographed effect is twelve. The Orloff machine could print all twelve at once, but the six-colour machine prints quicker and costs much less to build. Twice through the six-colour machine is said to produce the same result as twelve times through an ordinary colour press, and takes no longer times than two printings in the ordinary way. The edition of the "Absent-Minded Beggar" is the first issue from the Orloff Press in England.

Journal of the Society of Arts,

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FRIDAY, JULY 13, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

The results of the Examinations held at the end of last March are now ready.

Copies for gratuitous distribution to each candidate who attended the examination have been sent to each centre. Additional copies can be obtained, price 6d. each.

The dates for the Examinations in 1901 are provisionally fixed for Monday, Tuesday, Wednesday, and Thursday, March 18th, 19th, 20th, and 21st.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 9th July, too late for the results to be included in the Report of the Council. They lasted for 13 days.

Mr. John Farmer, who has acted as Examiner since 1895, was prevented by the state of his health from taking any part in the work, and the examination was conducted by Mr. Ernest Walker, M.A., Mus.Doc. Oxon., and Mr. Burnham Horner, the Assistant-Examiners.

The system of examination was the same as that for last year. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and for the pianoforte examination a selection from this list is sent to the candidates six weeks previous to the examination. For other instruments the pieces can be at once chosen from the general list. Candidates are then expected to play or sing the pieces which they have prepared, and in the third and fourth standards to play a piece, or a portion of a piece at sight, in addition.

In all, 566 candidates entered, and of these 546 were examined, an increase of 17 as compared with last year; 5 of these took up two subjects, so that there were 551 examinations. Of these there were 521 passes and 30 failures.

The following were the subjects taken up:—Piano, singing, violin, viola, violoncello, mandolin, guitar, and organ. 419 entered for the piano, 395 of whom passed and 2 obtained medals; 68 entered for the violin, of whom 66 passed and 1 obtained a medal; 1 entered for the violoncello and passed; 2 passed for the mandolin; 6 entered and passed for the organ, and 1 obtained a medal; 52 entered for singing, of whom 49 passed, 1 obtaining a medal; 2 entered for the viola and passed, and 1 obtained a medal; 1 entered for the guitar and failed.

The following Table shows the number of Candidates who entered for the various Standards, since the adoption of the present system in 1897:—

Subject.	1st Standard.				2nd Standard.				3rd Standard.				4th Standard.				Singing, &c. No Standards.			
	1897	1898	1899	1900	1897	1898	1899	1900	1897	1898	1899	1900	1897	1898	1899	1900	1897	1898	1899	1900
Piano	113	164	193	178	93	106	148	158	58	67	63	71	22	43	25	26	...	...	...	...
Violin	10	23	29	31	24	16	21	18	12	19	11	11	10	23	11	8	...	...	...	...
Singing	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	59	60	42	53
Other Subjects	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	6	8	12
Totals	123	187	222	209	117	122	169	176	70	86	74	82	32	66	36	34	62	66	60	65

The following are the total numbers of candidates who entered for the examinations in each year:—In 1897, 404; in 1898, 527; in 1899, 551; in the present year 566.

CHADWICK TRUST.

To the Council of the Society of Arts,

GENTLEMEN,

I have the pleasure to forward to you a report of the work done by the Trustees in connection with the above Trust, both before and during the period over which I have represented the Society of Arts as a Trustee.

The principal part of the work of the Trustees has been carried out under an Agreement entered into with University College, Gower-street.

The Agreement provides :—

1. That the Trustees should pay to the College a capital sum of £1,000 to be expended as follows :—

(*a*). The sum of £400 by the Professor of Hygiene for the purchase of apparatus and the equipment of a Laboratory of Bacteriology and Hygiene. Vouchers to be exhibited to the Trustees as soon as the money is entirely expended.

The apparatus so purchased, which will become the property of the College, together with any apparatus, now the property of the College, in the said Laboratory, shall be placed in a room or rooms within the College, set apart for that purpose, and shall be called "The Chadwick Laboratory of Municipal Hygiene." It shall be available for instruction, now given to medical men, by the Professor of Hygiene, as well as for the instruction in Municipal Hygiene, as hereinafter described.

An inventory of the apparatus and the apparatus purchased with the Trust funds shall be kept, and shall be open to the inspection of the Trustees or of a member of the Trust duly appointed by them.

(*b*). The sum of £200 shall be expended by the Professor of Civil Engineering for the purchase of surveying instruments and appliances. Vouchers for this expenditure shall be exhibited to the Trustees of the Trust as soon as the money is expended.

(*c*). The sum of £400 shall be expended in the purchase of cement testing apparatus, compressing testing machine for bricks, stones, cements, &c.

These appliances shall be placed in the General Engineering Laboratory and be used for the general instruction in Engineering requisite for students in Municipal Engineering.

The Professor of Municipal Engineering shall certify all the accounts before they are paid by the College Treasurer, and the Professor of Mechanical Engineering shall arrange with the Professor of Municipal Engineering as to the instruments and appliances to be purchased or made with this grant.

The instruments and apparatus provided by the Chadwick Trust shall be available for teaching purposes by the Professors of Civil and Mechanical Engineering.

The said instruments and appliances shall be styled "The Chadwick Gift to the Engineering Laboratory."

They shall be maintained by the College in like manner as the existing apparatus in the said Laboratory.

2. The Trustees will pay to the Treasurer of the College, in June and December of each year, a sum sufficient to cover the outlay provided for use in their resolution of July 5, 1897, but not exceeding £600 in all, for the expenses of the Chairs of Hygiene and Municipal Engineering, for Professors, Lecturers, appliances, &c.

The Trustees have agreed that the arrangements outlined below shall be carried out as regards the Chair of Hygiene.

(*a*). The maintenance and renewal of apparatus in the Laboratory shall be paid for out of the annual sum of £100 provided by the Trust for assistance, models, &c.

(*b*). That the Professor of Hygiene in consideration of an annual honorarium of £100 shall deliver a course of not less than 30 lectures and demonstrations on Practical Hygiene, distributed over two or three terms as may be most convenient, having regard to other courses of instruction conducted by the College.

(*c*). The said lectures to be styled the "Chadwick Lectures on Municipal Hygiene."

(*d*). The subject matter of the Chadwick Lectures shall be adapted to engineering students, and shall include the elements of Bacteriology and the general principles of Hygiene.

(*e*). These Lectures, though specially intended for engineering students, shall be open to all who wish to attend (women as well as men).

(*f*). The fee for the said course of lectures shall be £3 3s., and be paid to the College, part being allotted to the Professor in the usual manner.

(*g*). The Chadwick Laboratory shall be open to engineering students for the purpose of practical work, under the direction of the Pro-

fessor of Hygiene, bearing upon water, air, and gas analysis, bacteriological work, and such other kindred subjects as the students may wish to take up.

The fee for 20 days' attendance shall be £5 5s., including the use of chemicals, apparatus, &c., this fee to be paid to the College and allotted as usual.

(*h*). The Professor of Hygiene shall be at liberty to allot out of the sum of £100, provided by the Chadwick Trustees for assistance, a sum not exceeding £50 to the assistant professor for superintending the laboratory work above mentioned.

(*i*). An examination conducted by the Professor of Hygiene shall be held at the end of the course of instruction, and the College shall grant the usual medals and diplomas to successful students.

The necessary arrangements shall be made in time duly to advertise the classes, &c., in the College Calendar for 1898-9.

3. The Trustees have considered and approve of the following scheme of the Professor of Municipal Engineering for the organisation of the classes to be held under his control. The necessary hours of classes to be drawn up and advertised in the College Calendar for 1898-9.

The Professor of Municipal Engineering shall appoint at a salary of £150 per annum an Assistant Professor or Demonstrator to act under him. The said Assistant Professor to be a B.Sc. of some College or to possess qualifications equivalent thereto, and to have had practical experience in civil engineering. His services are to be at the entire disposal of the Professor, and he shall devote his whole time to the duties of instruction.

The course of Municipal Engineering shall consist of about 60 days' work in the drawing office, preparing plans of various municipal works, such as waterworks, sewerage, &c.

The students shall be free to attend (during office hours) the drawing office, whenever they see fit to do so, and the Assistant Professor shall be always present to help and direct their studies. Each day shall consist of three hours' work either in the morning or afternoon. The 60 days shall be distributed over the three terms of the year.

A course of about 15 lectures on Municipal Engineering shall be delivered by the Professor or by some competent person appointed by him. The honorarium for the lectures shall be paid by the Professor of Municipal Engineering out of the funds placed at his disposal, and the proportion of the fees allotted to him by the College.

The hours and dates of these lectures shall be arranged so as to fall in with those of the other Engineering courses.

An inaugural address by the Professor of Municipal Engineering will open the course.

The fee for the complete course of office work and lectures shall be £5 5s., paid as usual to the College, a proportion thereof being allotted to the Professor in the usual way, to be employed for the remuneration of the Assistant Professor and lectures, in addition to the fixed honorarium hereinbefore provided out of the Trust Funds.

At the end of the term an examination shall be held and marks allotted for the drawings made by the students, having regard to the neatness, accuracy and finish, as well as to the intrinsic merits of the designs.

4. The Trustees will institute a Chadwick Scholarship of £100, and a medal for each of three consecutive years, subject to the following regulations, which shall be printed in the College Calendar with the other College Scholarship Regulations: To a student who has passed with distinction the Matriculation Examination in Engineering established by the College and recognised by the Institution of Civil Engineers, as a qualification for admission as student of the Institution, or an examination of similar scope at some other recognised College or School, and who has also passed with distinction the examinations in Municipal Hygiene, and in Municipal Engineering.

This Scholarship will therefore be allotted to the student who—

(*a*). Has passed the Matriculation examination in Engineering or its equivalent.

(*b*). Has a First-class Certificate in the Engineering course, either in University College or some other College or School of like standing.

(*c*). Has the greatest aggregate number of marks in the courses of Municipal Engineering and Municipal Hygiene (provided that in both subjects sufficient marks are obtained to justify a First-class Certificate).

Provided always that the said Scholarship shall not be a free gift to the recipient, but shall be expended, under the direction of the Professor of Municipal Engineering, in the manner best calculated to enable the scholar to obtain practical experience in Civil Engineering.

The manner in which the Scholarship is to be expended will be settled by the Professor, after conference with the successful candidate.

This scheme is being carried out under the personal supervision of Mr. Osbert Chadwick and the Trustees, and in their opinion with satisfactory results. The actual work of the students commenced with the Session, 1898-1899, and the following reports set out in detail the work done.

University College, London.

REPORT ON THE MUNICIPAL HYGIENE CLASS, 1899.

The lectures were at first announced to be given once a week during the two terms from October to April, but it was found that the students could not attend during the first of these terms as the lecture hour clashed with that of one of the other classes. I, therefore, arranged to give two lectures a week during the second term (from January to March).

Four students (three men and one woman) took out tickets and attended very regularly, the Lectures being given on the subjects mentioned in the Prospectus of the Department of Applied Science and Technology, page 18.

Demonstrations were also given once a week on sanitary appliance, hygienic analysis, and bacteriological methods.

The students were also allowed to attend the visits of the practical class to important sanitary works.

Three of the students presented themselves at the Class Examination, one of whom obtained a First-class Certificate, having done exceedingly well in the examination. The others got Second and Third-class Certificates respectively.

W. H. CORFIELD,
Professor of Hygiene.

August, 1899.

University College, London.

REPORT ON THE WORK OF THE CLASSES IN MUNICIPAL ENGINEERING DURING THE SESSION 1898—1899.

(*a*). *The Lectures.*—Fifteen lectures on water supply and sewerage works were given between October and March. The number of students who joined during the first term was six, the average attendance from October to December being 4·3. During the second term two more students joined, and the average attendance was 4·7. In connection with this class a visit was paid on February 22nd to the new storage reservoirs in course of construction at Staines The number of students present was six, and it is believed that the visit proved both instructive and interesting to them.

(*b*). *The Drawing Class.*—This class was supposed to meet twice weekly for three hours at each meeting, but in consequence of overlapping with other subjects it was found impossible to get more than two or three students together at any one time, and all idea of having regular hours of meeting had to be practically abandoned. Each individual student had thus to get in his drawing during such odd hours as he might have free from his other classes. This circumstance, however, was not an unmitigated evil, as it meant that each student was able to receive a greater amount of individual attention than would have been possible had all been present at once. It is likely, however, that it led to some shirking of work on the part of some students.

The number of men who joined during the first term (October to Christmas) was six, of whom one did scarcely any work and left early in the term. Three more joined during the Easter term, bringing the total for the year up to twelve.

The work of this class was not confined to the subjects dealt with in the lectures, but consisted of a small number of exercises in general Civil Engineering, each case being completely worked out from the fundamental data to the preparation of a specification for the carrying out of the work and an estimate of the approximate cost.

Owing probably, in part, to the irregularity of the hours, and to the fact that the students had in most cases no previous knowledge of the subjects dealt with, which necessitated a considerable expenditure of time in the explanation of principles, as well as to the complete manner in which each exercise is worked out, the number of excercises taken was somewhat small, but the work was, on the whole, attentively followed and carefully carried out. It is likely that in the future it will be possible to increase the number of exercises by more regular hours, and by re-arranging the system of awarding marks, so that the time taken over each exercise will be taken into consideration more fully.

(*c*). *The Concrete Manufacture Class.*—Materials for this class were kindly supplied free of charge by Messrs. Bazley White, and Co., of the London Cement Company, and Messrs. Mowlem and Sons, of Westminster. The class is held during the summer term, and the work has consisted in the experimental determination of the percentage volume of th

voids in different specimens of broken stone, and the loss in volume per cent., which takes place when water is added to mixtures of cement and sand in different proportions so as to make a mortar. From these data the quantities of sand, cement, and water required for making a given quantity of sound concrete of given strength with the different sorts of broken stone were calculated. The results were then applied by making some 9-inch cubes of concrete to be afterwards tested for crushing strength. Test pieces were also made of the different qualities of cement mortar to determine their compressive and tensile strengths.

M. T. ORMSBY.

At the end of the Session Examinations were held, with the result that Mr. W. Percy Gauvain qualified himself for the Scholarship of £100 and the Chadwick Medal, as set out in the scheme. Both were duly awarded to him, and he has since been articled to Messrs. Hawthorne, Davy, and Co., of Leeds, for one year.

The Trustees have also awarded under the scheme to Staff-Surgeon Octavius William Andrews, M.B., R.N., the sum of £100 and a gold medal to be called the Chadwick Naval Prize for especially assisting in promoting the health of the men in the Navy.

Staff-Surgeon O. W. Andrews was duly nominated for such presentation by the Director-General of the Naval Medical Service of the Crown.

The Trustees being authorised, if they deem it necessary, to present a shield or medal, to be called the Chadwick Shield, to any Local Sanitary Authority which, having adopted the separate system of drainage advocated by the Testator, was able to show a material reduction of the death-rate of its district after five years' trial, as demonstrated by its Official Statistics of death-rates, duly advertised for Local Authorities who laid claim to the award. Very few applications were sent in, but the Trustees came to the conclusion that none of the drainage works (on behalf of which applications had been submitted) came within the definition of the separate system of drainage as set out in the scheme, and the award was therefore not made.

I am, Gentlemen,

Very faithfully yours,

R. BRUDENELL CARTER.

May 23rd, 1900.

AGRICULTURAL EDUCATION IN GREATER BRITAIN.

[A SUPPLEMENTARY NOTE.]

By R. HEDGER WALLACE.

In continuation of the paper read before the Society on February 27th, 1900,* I may be permitted to add a few notes, so as to extend and complete the data therein given. This I am now able to do through the receipt of various official circulars and papers which had been delayed in transit, and which therefore I was unable to utilise in the preparation of my paper.

First, as regards Ceylon, it seems a Commisssion was appointed in 1898, to consider what measures should be adopted to place the School of Agriculture at Colombo on a better footing, as it was not attracting a sufficient number of students, nor were those who sought admission coming from the truly agricultural classes. I cannot say what has been the practical result of the Commission's labours, but it seems to have been generally admitted that the school wanted reorganisation, with a larger staff of assistants, more scope for developing the practical side, and better means of reaching directly the rural population. In connection with the school a dairy was established in 1893 to supply all Government hospitals and asylums with milk. This establishment, which is in direct charge of a manager, working under the superintendent of the school, has proved successful, both as a model dairy and as a financial venture. About 1896 a branch forestry school was also established at the School of Agriculture under the auspices of the local Forest Department, with results that have been, so far, satisfactory. The School of Agriculture, or rather the School of Agriculture, Dairying and Forestry, is worked in connection with the Education Department of Ceylon, and maintained wholly out of the public revenues. The course extends over two years, and includes instruction in agriculture, botany, chemistry, veterinary science, and book-keeping; while English, arithmetic and elementary Euclid and algebra are also taught.

Instruction in theoretical agriculture is also given out of a primer on the subject in all departmental schools in Ceylon, from the fifth standard upwards in three stages. The teachers of these schools are induced by the Department to make use of the plot of ground attached to their schools for purposes of ornamental and economic gardening, and the pupils are also often engaged after school hours with the teacher in growing vegetables and other useful

* See *ante*, p. 325.

garden produce, and enter into the work eagerly, because a share of the outturn falls to them for home consumption.

Coming now to the West Coast of Africa, a study of the reports shows that on the west coast generally agricultural education is carried on to some extent, while on the Gold Coast it appears to be fairly well established, but the details given in the reports are not sufficient to allow of special notes being made.

Passing next to the West Indies, I have to supplement the notes made regarding the work of the Imperial Department of Agriculture under Dr. Morris by adding that at Trinidad (which was only incidentally referred to in my paper), according to the bulletin of miscellaneous information of the Botanical Department of that island, the Government there has definitely decided to establish a course of elementary agriculture in the rural schools. In order to prepare the teachers for this work a three weeks' course was instituted and held during August 1899. The course consisted of lectures and practical demonstations of the chief points of agricultural theory and practice, and the time was equally divided between the experiment station at St. Clair and the Government laboratory. During the summer vacation of 1899 a similar course of instruction for teachers was held at Castries, in St. Lucia, which lasted a fortnight and included lectures and practical demonstrations, and another course was held at Barbadoes.

In the West Indian section of Greater Britain a huge experiment in agricultural education is now being carried out, as pointed out in my paper, and it merits in my opinion careful attention. Its object has been succinctly stated as being, not an attempt to teach farming in schools, but "to have the entire youth of an agricultural country intellectually trained in an atmosphere favourable to agriculture, so that they should grow up interested in it."

The tendency of the educational system in all the West Indian colonies has been, in the past, to give the native peasant a distaste for agricultural manual labour, and to incline him to clerical work—at any rate, such are the conclusions both Royal and Local Commissions have arrived at. To remedy this a scheme of industrial agricultural education has been formulated, and this experiment in education pure and simple is now being carried out. Those who have devised it, however, seem to be aware of the dangerous ground on which it stands, for it is acknowledged that it may be made too practical, and "become little more than a device for the gratuitous cultivation of the teacher's garden;" or it may become too theoretical, and degenerate "into a mere repetition of misunderstood phrases from an agricultural text-book." Dr. Morris's scheme was referred to, and outlined in his own words, in my paper; but I am now able to give an account of the work undertaken by Dr. Morris, as it has been officially outlined and presented.

Three distinct schemes of agricultural instruction are being organised, intended to meet the needs of different classes of the community:—

1. Higher agricultural education to be imparted at existing high schools.

2. The foundation of new agricultural schools on apprenticeship lines.

3. The compulsory teaching of the principles of agriculture in all the elementary schools.

To meet the requirements of higher agricultural education the intention is to appoint lecturers in agriculture at the principal high schools and colleges in the West Indies. Such appointments have been made in Barbadoes and Jamaica, and are to be made in Trinidad and British Guiana. It is contemplated also to establish scholarships in the Windward and Leeward Islands to enable boys to pursue their studies in agriculture, at these high schools and colleges, as is already done in Barbadoes. This scheme is intended to benefit the sons of owners and managers of estates. In addition for the benefit of owners, planters, and managers themselves, experts are to be engaged who will lecture on the diseases of plants, bee-keeping, tobacco culture, and other subsidiary branches of agricultural knowledge.

The second and third systems are intended to benefit the peasant classes. To carry it out a knowledge of agriculture is to be made compulsory on all who wish to become teachers, while instruction in agricultural subjects is also to be compulsory in all elementary schools. The most promising of the elementary school scholars, under this system, will then be able and will be encouraged to go through a five years' apprenticeship course in agricultural farm or working schools which are being established. As a further inducement to enter upon this latter course it is stated that preference will be given to promising boys trained at these schools in making appointments to junior posts under the West Indian Imperial Department of Agriculture.

Though much undoubtedly has been and

is being done throughout Greater Britain, in respect to agricultural education, I think the West Indies at present offers the most interesting problem. The scheme of agricultural education which has been drawn up for this area appears to be both well devised and comprehensive. If it be effectual it means not only a change in the educational system of these Crown colonies, but a revolution in West Indian Agriculture which must affect the material welfare of the population.

INDIAN ANCESTRAL FESTIVALS AND WAYSIDE ARTS AND CRAFTS EXHIBITIONS.

At the interesting luncheon given by the Worshipful Company of Girdlers on the 16th May to the Secretary of State for India and the Indian Council, in commemoration of the Persian carpet presented to the Company in 1634 by Mr. Robert Bell, their Master in that year, and one of the first members of the East India Company, chartered by Queen Elizabeth in 1600, Sir George Birdwood proposed the toast to the memory of Mr. Robert Bell, and the following extracts are taken from the speech, reported in the current number of *British Indian Commerce*, with which he supported the toast:—

Indian Memorial Feasts and Wayside Arts and Crafts Exhibition.

"I have all the profound, worshipful reverence of the Greeks and Romans, and of the Hindus, and which still subsists even among the Parsees, for the dead, not only the illustrious dead, who have built up the material and moral glory of mankind, but the common dead, the forebears of the living of to-day. The sentiment is at the foundation of all natural and instinctive, and therefore frank religions, and one of the most painful things to me is the way in which it has been allowed to pass so completely out of the popular life of this country; until now probably very few recognise that the aboriginal source of all guilds, whether Roman or Teutonic, was in obsequial rites and burial clubs. I believe that the members of the actual Company of Girdlers had, down to a comparatively recent date, the privilege of being carried to the grave from this hall, to which the mourners returned after the interment and dined here together. In the pagan times of Europe, as still in India—*i.e.*, India of the Hindus—every meal was a sacrament of the dead as well as of the living, and every feast an act of worship: and it is, in a word, the solemnity of today's function that makes it so acceptable to me, and I trust that it will become for the future, in the literal sense of the word solemnity, an annually recurring function. It recalls to me the last banquet of the sort at which I was present, as a spectator, forty years ago, in Bombay. A Parsee family were celebrating their great annual festival of the forefathers. The tables were laid out with the most exquisite flowers, and every variety of those delectable and most fascinating Eastern sweetmeats, which, whether at Constantinople, Damascus, Cairo, or Bombay, are always to be recognised, from the descriptions of Athenæus, as the sweetmeats of the Greeks. As the time passed, and the flowers began to droop, and the sweetmeats to look dry, the elders whispered to the children:—'See! See! the blessed spirits are partaking of the feast we have spread for them! Their blessing be on us!' Then, the dead being satisfied, the living gathered up and ate of what remained. I am told that this gracious festival has become much sophisticated in character during the past thirty years, and that now it is little more than a graceless English banquet, preserving only in its name its sacred origin. But, as simply kept in my time, it was the counterpart of the Athenian festival of 'the Opening of the Grave,' celebrated at the time of the annual 'Feast of Flowers'; and how wine came to be introduced in that All Souls festival is deeply interesting, and very suggestive. The Greeks used the same word for the grave, or rather for their earthen burial jar, and their wine jar, and so in time the 'Feast of the Opening of the Grave' came to signify the 'Feast of the Opening of the Wine Jar,' and, as has happened with the Anglicised Parsee All Souls festival in Bombay, gradually degenerated into a brutish carouse. Another reason why to-day's function is so delightful to me is because it recalls another custom to be yet more widely observed in Western India; where, in the great polytechnical cities, such as Ahmedabad, Baroda, Surat, and Bombay, when a craftsman completes some work, on which he has been long engaged, to his unexpected satisfaction, rejoicing in its artistic charm, which he attributes to the direct inspiration of the Divinity, he at once lays it out on any open space of ground near his house, and calls all his caste fellows together to rejoice with him over it; improvising a simple feast of sugared Sesame seeds, which they pass from hand to hand, saying to each other:—'Always think kindly of me!' or, 'Let there always be kindness between thee and me!' It was thus that the Teutonic trade guilds and the Roman craft guilds gradually grew out of primitive burial customs, and wayside 'Arts and Crafts Exhibitions.'

Western Arts Guilds, and the Vicissitudes of European Art.

"Of course, whether an object of industrial art is artistically perfect or imperfect, is not a question of whether the Brompton-road or the King's-road is the best way to Putney. It is not an indifferent question, and it cannot be treated indifferently. In Persia even to this day every carpet is consciously designed and wrought as a symbol of the Universe, regarded as the Garden, the Paradise, of God. And throughout Anterior Asia the commonest names for the little

rugs imported into Europe in such numbers during the famine which raged some years ago in Persia, is, 'the Place of Prayer.' We in England have for generations lost the tradition and the inspiration of this serious view of art—at least of the industrial arts—and one of the most interesting points in the history of craft guilds since the introduction of Christianity into the West, is their close connection with the vicissitudes of art in Europe. The Roman craft guilds were intimately associated with the temples of the gods, and the first thing the Christians did on securing the Imperial power was not only to overthrow the temples of the old religion, but to disestablish, and break up the colleges of artificers that lived by it. But, in the process of time, the old guilds were revived, and new ones grew up, particularly in the Teutonic lands, including England, in association with the Churches of the new religion; and when this in its turn yielded in England, and elsewhere, to the fury of the Protestant Reformation, not only were the Catholic Roman churches desecrated, dismantled, and, in many cases, destroyed, but the craft guilds supported by them were once again more or less completely disorganised. This second break in the continuity of artistic culture in Europe goes far to account for much that is defective in both our national industrial arts and domestic handicrafts.

The Ancient Ritual of Health Drinking.

"I have already trespassed too long on your courteous indulgence, but before proposing the toast entrusted to me I would wish to say, if one in my humble position may do so without undue presumption, how much the honour of this occasion is enhanced for all of us who are here to-day, by the fact that your Master for the year happens to be the Lord Mayor of London, and that Lord Mayor, the Right Hon. Sir Alfred James Newton, whose name is being applauded by the wide Empire for the prompt, energetic, and public-spirited lead he took in the organisation of The Lord Mayor's Own' Corps of Imperial Volunteers for service in South Africa. No Lord Mayor of London has sustained the reputation of his high and beneficent office with greater advantage to the State, or greater honour to the City of London; and in the long list of his famous predecessors posterity will read no brighter name, as 'exemplar lode-star and guide' to his successors, than that of Sir Alfred Newton; and men will say of him, as they used, when I was a boy, to say of Sir Peter Laurie [1832-3]:—

'A good Lord Mayor,' will be—Sir Alfred Newton.

Not impossibly, his Lordship's office as Master of your Worshipful Company may involve him before the year is out in an amusing dilemma as Lord Mayor. He will presently be entertaining the Shah of Persia at the Guildhall, and, strangely enough, it happens that one of the highest dignitaries of His Majesty's Court is the Master Girdler. My authority for this statement, let me say, is the botanist, Kæmpfer, and no one later. His one duty is to carry a standard girdle, with which to measure the waists of His Majesty's wives—who are numerous. If they are under the standard they are fed up to it, if above starved down to it. If by some stage play freak of accident your Master should be called upon to discharge this embarrassing office, we are all certain that once again, in small things as in great, Sir Alfred Newton will show himself equal to the occasion. I have now the very great honour to call upon you all present to fill your glasses, and drink to the cherished memory of Mr. Robert Bell, Master in 1634, and we will, each according to his capacity, drink the toast in conformity with the old mystic ritual—in three draughts, or in three times three draughts:—

'Ter bibe, vel totiens ternos, sic mystica lex est
Vel tria potanti, vel ter tria multiplicanti.' "*

THE GEOGRAPHY OF TEA.

The following extracts from an exhaustive paper on the Geography of Tea are taken from *The Tropical Agriculturist* (Ceylon). The special points relative to the commercial geography of tea may be grouped under three headings:—

1. The principal localities of growth.
2. The principal areas of consumption.
3. The principal trade routes for transit.

(1) The Principal Localities of Growth.

In the popular mind China still stands as the great producer, and, although reliable statistics of internal production and consumption are difficult to obtain, it is probable, having in view the immense population of that vast empire, and the very general use there of tea, that the Chinese production is in respect to total quantity much the most important. But China is no longer regarded as the home of the tea plant. Investigations have fairly and reasonably proved that tea is indigenous to the valleys of Upper Assam, and, proceeding upon the theory that a plant will thrive and develop best in what is its place of origin, the conclusion has been formed that the tea plant of China is merely a debased variety of the indigenous Indian growth.

Probably Manipur was the birthplace of the tea plant, as the variety of tea known by the name of that native State has been the most successful and the most continually in favour with the planters. This State, lying just outside the tropics—an extensive valley with numerous hill ranges around it, densely clothed with jungle and large timber—seems to have developed those striking characteristics of the *Thea Assamica*, which differentiate it so markedly from *Thea Sinensis*. In a climate where there is an

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* Ausonius: *Edyllia*, "Griphus Ternarii Numeri."
Compare Horace, Carminum III., xix. "Ad Telephum":—
"tribus aut novem
Miscentur cyathis pocula commodis."

abundant and fairly well regulated rainfall, and a moist, steamy atmosphere, with a cold, dry season to rest and ripen after growth, the tea plant attained its highest development. Its existence in India and the native States bordering thereupon was unknown, or at least unacknowledged, till 1834; but as the Province of Assam was gradually explored and became developed by the constantly increasing tea industry, there were found scattered through it and the adjacent districts many tracts of indigenous tea.

From Yunnan the cultivation of tea doubtless spread eastwards and northwards, crossing ultimately from the mainland to the Island of Formosa and later to Japan.

Vigorous but ill-advised efforts were made to introduce the cultivation of tea into India, and seeds and plants of the debased China variety were imported. With those came Chinamen and Chinese methods of planting, cultivation, and manufacture—much to the detriment of the industry, the following 40 or 50 years being occupied in getting away from everything Chinese, and through the costly experience of mistaken and misdirected effort, the poor planter and investor acquired the excellent methods upon which the Indian tea production is now worked—worked so excellently, indeed, as to have practically destroyed the export trade for certain classes of the tea produce of China. Clearances of jungle were made, including tracts of the indigenous Assam variety not then recognised, and the extensive province of Assam, with its magnificent waterway, was gradually opened up, the greater part of its area being carefully explored in the light of tea possibilities with a thoroughness that might gratify any geographical society.

Following the success in Assam, tea was planted in various parts of Bengal and other provinces of India with more or less success until, in 1897, the area was officially stated to be equal to 200,000 hectares. The greatest success has been along the line just north of the tropic of Cancer, in the latitude where the principal part of the Chinese cultivation lay.

The two largest developments of production outside of India, China, and Japan, have been on the Islands of Ceylon and Java, both lying as to longitude in or near what might be termed the Tea belt, and about equidistant from the Equator, one to the north and the other to the south. In those the existence of high mountains, heavy rainfalls and climates forcing continuous growth have made the production of tea commercially successful, although on lines materially differing from those followed in both China and India.

(2) The Principal Areas of Consumption.

If it is a curious and interesting fact that almost the entire production for the world, of tea, is raised within an area confined by 40 degrees of latitude and 60 degrees of longitude, it is equally curious that the consumption shows itself to have strictly geographical limitations. Outside of the domestic consumption of China and Japan, regarding which no reliable statistics can be obtained, the principal tea drinkers are the people of Great Britain, Ireland, and of the British Colonies, the people of Russia and those of the United States of America.

Excluding the requirements of those Mongolian peoples, the world's consumption of tea may be taken roughly at 230,000,000 kilogrammes of tea per annum, a quantity which, including cost of transportation to the countries of consumption, but excluding revenue duties and distributive profits, may be valued at abont £17,000,000. The huge volume of this will be better appreciated when it is stated that the large passenger liner, the *Kaiser Wilhelm der Grosse*, would have her cargo space entirely filled 232 times over were she engaged transporting it. To put it another way, the quantity of dry tea leaves is sufficient to make an infusion of 28,000,000,000 litres of liquid tea, or 100,000,000,000 ordinary tea-cups, being one for each day of the year for every five persons of the present estimated population of the entire world.

The Southern Hemisphere ranks lightly in the matter of population, and its tea consumers live south of the tropic of Capricorn in South Africa and Australia; but if they are few relatively they consume heavily, the average consumption per head in Australia being nearly 4 kilogrammes per annum.

In the Northern Hemisphere (again excluding the races who consume their own produce) the material consumption of tea is in regions lying 40 degrees north and above it, but here there is an interesting subdivision to be made. In the United States and Canada, in some portions of Europe and of Asia, and along the north of Africa there is a free use made of green or unfermented teas with pale pungent infusions. The demand for such, as a general rule, lies principally in lower latitudes, while the further north the consumer lives he seems to require more of the black or fermented tea of India, Ceylon or China, with the dark, thick, heavy liquor its infusion produces.

Great Britain and Ireland take much the largest total of imports, the quantity in 1898 being 107,000,000 kilogrammes, but per head this only amounts to 2·65 kilogrammes per annum of the population, or a good deal less than is taken by the British Colonies in Australasia.

Next to Great Britain comes Russia as a consumer of 42,000,000 kilogrammes, but that only represents about ·34 kilogrammes for each of the population, the poverty and not the will of the people probably accounting for the small figure, as they are really great users of tea, but take it exceedingly weak, and draw the spent leaves until no colouring matter is left in them.

The United States is a large consumer in point of total—31,000,000 kilogrammes, but this is only ·41 kilogramme per annum for each of the population, although the United States people are great coffee drinkers, taking 5 kilogrammes per head per annum of coffee. Besides, the population is of such

a composite character that it includes many people not by descent tea drinkers.

Except Canada, which follows the customs of its mother country and sister colonies by consuming about 2 kilogrammes per head per annum, and Holland, which takes roughly $\frac{1}{2}$ kilogramme per head there is no other country whose consumption, either in total or per head calls for special notice.

(3) The Principal Trade Routes for Transit.

As the trade grew in importance the advantages of rapid transit for the tea of new season's production began to be appreciated, and the slow and stately progress of the old East Indiaman grew out of date. A type of vessel specially designed for the rapid carrying of tea from China to England *viâ* the Cape of Good Hope, was introduced, known as the "China Clipper," and the competition was always keen as to which ship should make the most rapid passage. This culminated in the year 1866, when nine ships sailed almost simultaneously from Foochow, three of them crossing the bar in company. Those three were all built by the same builders in Greenock, and came in ahead of all the others, making the long voyage of fully 16,000 miles in 99 days. They each docked in a separate dock in London upon the same day, and all within two hours of each other. The two leading ships had not seen each other for 70 days, and met off the Lizard, from which point they ran a neck-and-neck race before a strong westerly wind, with every rag of canvas set.

The opening of the Suez Canal in 1869 soon changed the course of all trade with the East, and in a few years the sending of tea per sailing ship round the Cape of Good Hope was a thing of the past. Romance was no more, although there was extreme competition in building steamers with great power and speed to land their cargoes rapidly by the new route. This culminated in 1882, when the s.s. *Stirling Castle* made the phenomenal run for those times, of twenty-eight days from Woosung to London.

But England, which formerly supplied almost everything to her own colonies and to many foreign countries besides, has under the modified conditions of abundant steam tonnage everywhere, become less and less of a distributive country. Consequently, direct shipments are made now from the countries of production to those of consumption. America gets its tea largely through its western sea-board from China, Japan, Ceylon, and India, while not a little is reaching it of recent years by steamers running direct from those countries *viâ* the Suez Canal to New York. The Australian demand is fed by steamers from Chinese ports, from Calcutta and Colombo.

The extensive Russian trade is still done in its major part by overland transit by caravan, and partly by river and railroad, and this, next to the transit to London, represents much the largest volume of tea traffic passing in one channel. For the purpose of this trade the greater portion of the tea supply is compressed into what is termed brick tea, the bricks being flat tablets weighing about one kilogramme each. The supplies are packed and prepared at various tea ports in China and concentrated at Tientsin, from where they are despatched. An enormous traffic with Siberia takes place in these, and the baskets into which they are made up are sent by camel caravans out of the Kalgan Gate of the Great Wall through Manchuria or Mongolia to Kiakhta, and thence distributed through Siberia. In some cases the shipments are made by sea to Nikolaevsk, and thence by water up the Amur river.

One of the most interesting developments of modern trade—in which tea is an important factor—is the opening up of traffic through the Kara Sea into the Obi and Yenisei rivers, with which the name of Captain Wiggins has been associated. By this route for several years past considerable quantities of brick tea have been conveyed entirely by water from Chinese ports, with trans-shipment in London, to steamers proceeding up the Gulf of Obi to Tieumen for sale at the fair which is held annually in February at Irbit. This journey, although about seven times as long in point of mileage as the old caravan route, can be done in about four months as against eighteen by the other way, and it is of course much less expensive. The partial opening of the Siberian Railway has affected the trade route, and when there is through transit across Siberia to Vladivostock, and possibly Port Arthur, to Europe, the Russian tea trade will probably be subjected to further rearrangement of routes.

Another recent development in connection with the Russian tea trade has been that of the great Russian Volunteer Fleet in calling at Chinese ports and Ceylon, and carrying from them large quantities of tea to Odessa for distribution to Moscow, Nijni Novgorod, and other points.

Other most interesting trade routes are those for the supply of Persia, Turkestan, and Afghanistan, partly through the Persian Guf on to Meshed, and partly through the Black Sea to Trebizon and Tabreez.

In the discussion which followed the reading of the paper, Professor Andreas Krassnow, from Kharkoff (Russia), expressed the opinion that the tea plant must be indigenous, not to Assam only, but to the whole monsoon region of Eastern Asia, where it grows wild as far north as the islands of southern Japan. Dr. Krassnow collected in many parts of the island of Shikoku in Japan, and in the environs of the town of Kochi, wild growing plants. They occur in the dense forests on the slopes of mountains which have never been cultivated in the province of Japan, and are even now not thickly populated. Like the English in Assam, the Japanese are cutting down and felling the forests, but they are leaving the tea plants to grow in the form of plantations of wild tea, from the leaves of which they produce different kinds of tea of inferior quality. Not only common Japanese green tea is prepared, but two or three inferior sorts,

whose qualities resemble much the material from which the Chinese make their brick tea.

The wild tea grows to a height from 3 feet to 5 feet, and the flowers are a little smaller than those of the cultivated form, but the leaves are not re-curved on the edges. In some forests the plant is very numerous, in others it occurs more rarely, and is found amongst other evergreen shrubs, growing in the shadow of *Quercus glabra*, and similar trees, which largely make up the evergreen forests of Southern Japan.

Dr. Krassnow believes that the tea plant existed in China and Japan long before it was introduced in cultivated form, and that the peculiar properties of the China plant were produced, not by cultivation in a colder climate or on exhausted soil, but by the changes of climate which have taken place in Eastern Asia since the Tertiary Epoch. The period of cultivation of tea has been too short to produce the differences which exist between the Chinese and Assam plants, and many botanists consider them to be different species. It is well known that the Assam plant is frozen by temperatures which the China plant bears very well, and that the hybrids which are cultivated in hot climates, approach more to the Indian, and those in colder climates to the Chinese plant. The hybrids suffer from the cold winters in Batoum, which the Chinese plants never do. On the other hand, China plants cultivated in hot climates never become so tall and never have such large leaves as the Indian. Professor Krassnow has given these facts with more details in his book, "On the Tea-producing Districts of Asia," bringing out the conclusion that the tea plant since the remotest times formed two varieties—Assam and Chinese—the first growing wild in India, and the other occurring still wild in Southern Japan (and perhaps in Formosa) where they were discovered by aborigines after the introduction of the cultivated form from the south-west.

THE DOLL TRADE IN THURINGIA.

The toy trade may be traced back in Thuringia to the Middle Ages; it is the predecessor of the doll trade, which is of a much later date, the first doll having been manufactured about forty or fifty years ago. Simple as a doll may appear at first sight, the work needed for its completion is complicated. Consul Hughes, of Coburg, says that the commonest kind of doll now in the market is the one which goes under the name of "wax doll." Its trunk is made of cheap shirting, stuffed with sawdust; its legs and arms and head are usually of *papier-maché*, the last having a thin wax covering, a coarse shirt completes this very poor and simple style of doll, and yet many hands have been engaged in getting it ready. Certain workmen make the arms and legs, either by cutting them out of wood or by moulding them of *papier-maché*; others arrange the limbs in flat, wooden boxes, which are put near the stove or in the sun to dry; others dip the arms and legs into a basin containing red dye, to give them a flesh-like appearance, others sew, cover, and stuff the doll; others paint the eyebrows, lips, and hair, if the last be not merely indicated by paint, mohair is glued on. The manufacture of the glass eyes, as well as the fixing of the same in the head, is again done by different people, and all the parts are put together by a small manufacturer who usually lives in the town, and to whom the workmen engaged in the manufacture of parts of dolls carry the product of their weekly toil. Model dolls are quite similar to the wax dolls, with the exception that they are provided with heads made entirely of wax. In the manufacture of mat dolls, the limbs and head are dipped into a solution which is supposed to make them washable. The making of fine doll wigs must be considered an art by itself. Mohair, which is imported in large quantities from England, is used in this manufacture; sometimes human hair is employed, but the latter material being expensive its use will always be limited. The consumption of china bisque heads is very large, and about a dozen factories are engaged exclusively in manufacturing them, two new ones now being built in the neighbourhood of Coburg. The mass, out of which china heads are made, consists of china clay, quartz sand, felspar, and kaolin. These materials are put into iron drums and mixed, ground between flint stones and wetted. The mixture is filled into hollow gypsum forms, and remains long enough to allow part of the mass to settle on the inner surface of the mould and become firm. The remainder is poured out again, and the gypsum forms, which consist of two parts, are removed, so that the china heads in their unfinished state are left. Before they have become quite hard, all roughness is removed from the surface, and the spaces for the mouths and eyes are cut out. Next the heads are exposed in ovens to an intense heat for about three days; they are then painted and placed for a few hours in another kind of oven, so that the paint is burnt in. The glass eyes are blown out of tubes held over a strong gas flame; they are connected by wire, and if it is desired to make them movable a lead weight is fastened to the wire. The dressing of dolls is also an extensive industry, manufacturers employing up to 200 or 300 hands, mostly girls. Of recent years dolls are brought out dressed in uniforms to represent some well-known character. Dolls dressed in khaki are now being sent to the English market from Thuringia.

Notes on Books.

TEA MACHINERY AND TEA FACTORIES: a Descriptive Treatise on the Mechanical Appliances required in the Cultivation of the Tea Plant and the Preparation of Tea for the Market. By A. J. Wallis-Taylor. London: Crosby, Lockwood, and Son. 1900. 8vo.

Many works have been published upon the chemistry, and upon the cultivation and process of manufacture or preparation of tea, but the author claims that his is the first work published in book form dealing specifically with the machinery utilised in tea factories. When tea planting was first introduced into the British possessions little, if any, machinery was employed, but now its use is almost universal. The author introduces his subject with these preliminary remarks:—"Assuming the best jât or type of tea plant, the most suitable description of soil, the proper elevation, and the most appropriate climate, to be points already satisfactorily settled, there still remain two matters of the greatest importance, the neglect of which will prevent the best possible results being secured from a tea plantation. These are—the suitable cultivation or tillage of the soil, and the provision of a properly-constructed and located factory, replete with first-class machinery and appliances for the dressing, manufacture, or preparation of the leaf."

The author deals in the first chapter with the mechanical cultivation or tillage of the soil, in the second with the various systems of plucking or gathering the leaf, and in the third with the choice of site for the tea factory, the most suitable materials for building it, and the internal arrangement of the factory. In the following chapters the various processes of preparation of tea and the machinery used for the purpose are fully described. The twelfth chapter is devoted to the modes of packing tea, the machines for the purpose, wooden and metal tea-chests and boxes. After this two chapters are occupied by a full treatment of the means of transport on tea plantations such as roads, bridges, portable and permanent railway lines, steam and electrical traction, aerial or wire rope tramways, telpherage, wire-rope chutes or inclines. The final treatment of tea by mixing, blending, and bulking machines, packeting or parcelling machines is then dealt with, and the last chapter is devoted to a series of Tables and useful memoranda on various mechanical points, estimates, &c., on tea analyses, adulteration with foreign leaves, Indian weights and measures, &c. It will be seen that this volume contains a very full account of the machinery necessary for the proper outfit of a factory, aad also a description of the processes best carried out by this machinery. The book is very fully illustrated and contains an elaborate index.

THEATRES: THEIR SAFETY FROM FIRE AND PANIC: THEIR COMFORT AND HEALTHFULNESS. By William Paul Gerhard. Boston, Mass. 1900. 8vo.

This volume deals with two distinct subjects, and the second — the comfort and healthfulness of theatres, might perhaps have come first, as it is of nightly importance; while it may be hoped the dangers from fire are more remote than the dangers to health from ill-ventilated buildings—which are ever present. In 1898 the author stated in a paper on "Theatre Sanitation" that "chemical analyses show the air in the dress circle and gallery of many a theatre to be in the evening more foul than the air of street sewers," and this expression of opinion has been corroborated by figures. The author after pointing out the need of proper ventilation, of satisfactory methods of heating and of the necessary attention to the requirements of sanitation in all parts of the theatre, urges that a sanitary inspection of all theatre buildings should be instituted once a year, when they are closed in the summer, and that the annual license should be dependent, not only on one condition of the safety of the building against fire and panic, but also upon its sanitary condition. If necessary, the disinfection of the house should be repeated several times a year, particularly during epidemics of influenza. Safety measures against outbreak of fire may also be classed as sanitary improvements. The essay on "Safety from Fire and Panic" was originally prepared for the publications of the Fire Prevention Committee of London, and Mr. Edwin O. Sachs, in a preliminary note, speaks of Mr. Gerhard as the leading authority on the subject in the United States. The importance of the inquiry is seen from the fact that the average number of theatre fires per year is on the increase, "while the average number of fires in the last thirty years is twenty-seven, the average of the last twenty years is thirty-three, and that of the last ten years is thirty-six."

The author enumerates eight safety measures for fire protection:—

1. To permit the audience and the stage *personnel* to make their escape safely in case of either fire or panic.

2. For the prevention of an outbreak of fire, and for quickly detecting and signalling a fire outbreak.

3. For protecting the playgoers against fire and smoke.

4. For the protection of the stage *personnel*.

5. For confining a fire to the stage and preventing its spreading.

6. For saving life.

7. For fighting fires in their incipiency.

8. To guard against a panic.

Each of these points is discussed in this book.

THE ROMANO-BRITISH CITY OF SILCHESTER. By Frederick Davis, F.S.A. London. 8vo.

The author gives in this small volume an account of the interesting series of excavations undertaken by the Society of Antiquaries, by which a considerable amount of light has been thrown upon the mode of life in Britain during the Roman period. The exploration of the buried city of Calleva Attrebatum was first undertaken by the Rev. J. G. Joyce in 1864, who continued his researches for several years, and these labours were carried on by other antiquaries after his death. Since 1890 the site has been systematically explored by the Executive Committee of the Silchester Excavation Fund, under the auspices of the Society of Antiquaries.

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FRIDAY, JULY 20, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

CHAIRMANSHIP OF COUNCIL.

On Monday, 11th inst., at their first meeting after the annual election, the Council elected Sir John Evans, K.C.B., F.R.S., as Chairman for the ensuing year.

Proceedings of the Society.

CANTOR LECTURES.

THE NATURE AND YIELD OF METALLIFEROUS DEPOSITS.

By Bennett H. Brough.

Lecture I.—Delivered January 22, 1900.

The subject of these lectures is of great importance from a commercial point of view, as will be evident from a moment's consideration of the enormous value of mineral resources. In the United Kingdom alone, the value of the minerals raised in one year has approached £80,000,000; and the vast sums representing the British capital invested in mines in all parts of the world will be readily appreciated. Last year, the number of new mining companies registered in Great Britain was 559, with a united nominal capital of £71,687,366. Of these companies, 281, with a nominal capital of £37,037,057, were formed to mine and explore in British colonies and dependencies, and 157, with a nominal capital of £24,049,502, to mine in foreign countries. During the present century, the mining industry has made remarkable strides. Some indication of the progress made, even during the past ten years, is afforded by a comparison of the world's output of metals in 1889 and in 1898. In round numbers, the production of the principal metals was as follows:—

	1889.	1898.	Value of output in 1898.
	Tons.	Tons.	£
Pig-iron	26,000,000	36,000,000	100,000,000
Gold	182	430	57,500,000
Silver	3,900	6,000	24,000,000
Copper	266,000	431,000	21,750,000
Lead	549,000	770,000	10,000,000
Zinc	335,000	468,000	9,950,000
Tin	55,000	77,000	8,000,000
Antimony....	11,000	28,000	1,100,000
Mercury	3,838	4,100	815,000
Nickel	1,830	6,200	725,000
Aluminium ..	70	4,000	440,000

In this course of lectures I shall endeavour to describe the principal ore-deposits from which these vast outputs have been obtained. During the 146 years of its existence, the Society of Arts has taken a leading part in the encouragement of mining art and commerce, and it seems fitting that, at the close of the century, its *Journal* should contain a review of the sources from which the world's present supplies of metal are obtained, and an attempt to forecast what alterations may be expected in the near future.

Ore Deposits.

Any mineral which is obtained by mining, and contains a workable proportion of metal, is called an ore. Ores are met with in various forms and in various positions in the earth's crust. Sometimes they are found in gravel, sand, and other alluvial deposits. It was gold deposits of this class that attracted the great rush of adventurers to California in 1849, and to the Klondike in 1896. In many cases the deposits consist of recent gravels containing gold, deposited by rivers still in existence. Similar deposits of ancient river systems, protected by a thick cover of lava, form the so-called deep leads or placers that have been largely worked in California and New Zealand. Other examples of this class are afforded by the gold deposits on the sea beaches of Cape Nome in Alaska, the tin stream-works of Cornwall, the alluvial tin-fields of the Malay Peninsula, and the bog iron ores of various localities.

In other cases the ores occur in regular parallel beds or seams interpolated between

rocks of sedimentary origin, as in the case of the iron ore of Luxemburg and Lorraine, and in that of the auriferous conglomerate of the Witwatersrand. Again, ores are met with in tabular masses, known as veins, lodes, or reefs, differing in character from the enclosing rocks. The tin veins of Cornwall, the great Mother Lode of California, and other veins of auriferous quartz occurring in different parts of the world, are examples of this class of deposit. Lastly, the ores may occur in detached irregular masses. Such, for example, are the iron ore deposits of North Lancashire, and of the Forest of Dean, and the iron mountains of the north of Sweden.

The simplest classification of ore deposits is based on their form, and divides them into (1) beds, (2) veins, and (3) masses. This is the classification adopted by Professor C. Le Neve Foster in his treatise on ore and stone mining, and it has proved well adapted to practical use. The more elaborate systems of classification that have from time to time been proposed will be discussed subsequently.

Beds.

You are all familiar with the broad division of the rocks which form the earth's crust into stratified and unstratified. In the former, we have a number of parallel layers, or strata, or beds; whilst in the latter no parallelism is exhibited. It frequently happens that a member of a series of stratified rocks consists of material of value to the miner, as in the case of coal or rock salt. In many cases such bed or seam forms a repository of metalliferous minerals. The greater portion of the iron ore mined in this country is obtained from beds, in the Cleveland district and in the Midland counties. The most important deposits of gold ore in the world, the auriferous conglomerates of the Transvaal, are beds. Large quantities of copper are obtained from beds in the Lake Superior district, and at Mansfeld, in Germany. Among bedded deposits, too, we have the lead ores of Mechernich, and the silver ores of Stormouth, in Utah. The thickness of workable beds varies within wide limits. The valuable portion of the Mansfeld bed of copper shale is only 3 to 7 inches thick, whilst that of the Mechernich lead-bearing sandstone exceeds 100 feet in thickness. Although subject to variation, beds are much more uniform, both in thickness and in composition, than veins, the second great class of ore-deposits, which we will now consider.

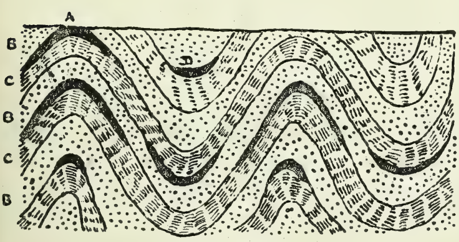
Veins.

This type of deposit presents problems of the greatest complexity, and still offers a fruitful field for investigation and speculative inquiry. A mineral vein is usually defined as a repository of mineral matter that fills, more or less completely, a former fissure in the earth's crust. Although this definition is undoubtedly accurate in most cases, deposits, such as the Lake View and other important veins in Western Australia, are met with, in which the rock at the sides of the fissure has been so altered as to render it worth working, and it should be considered as part of the vein. These cases are included in Professor Le Neve Foster's more general definition that mineral veins are tabular deposits of mineral that have been formed subsequently to the rocks by which they are surrounded. Fissures in rocks may have been formed either (1) by variation in the volume of the rock due to cooling, desiccation, or chemical action, or (2) by unequal mechanical pressure due to movements of the earth's crust, such as earthquakes, upheavals, or depressions of the surface, and the contortion of the strata. These causes also serve to explain the formation of cavities in the vein. The depth of the fissure is naturally dependent on the mode of its origin. The silver lead veins of Przibram, in Bohemia, which have been worked to a depth exceeding 3,000 feet, and the gold quartz veins of Victoria, which have been worked to a similar depth, offer examples of the persistency of mineral veins at the greatest depths hitherto reached by mining operations. Veins are very variable in width, from a mere film up to 150 feet or more. Their longitudinal extension is equally variable. The Great Mother Lode of California has been traced for a length of more than 70 miles. The largest silver lead vein in the Upper Harz is known for a length of 10 miles, and the Spital gold vein at Schemnitz, in Hungary, has been followed for 5 miles. Veins very frequently exhibit changes in width, being apt to diminish gradually. This thinning out cannot be regarded as a sure sign that the end of the vein has been reached, experience showing that in very many cases the thinning out of a vein is followed by a widening. When the vein decreases in width, and then increases at short distances, it is known as a lenticular vein, owing to the fact that the vein spaces consist of a series of lenticular masses.

Veins, with sharply defined walls, traversing the enclosing rocks independently of their stratification, are the so-called true fissure

veins so dear to the authors of mining reports. Such veins do indeed exist, but they are the exception rather than the rule. When the veins are conformable with the stratification of the surrounding rocks they are known as bedded veins. In sedimentary rocks, bedded veins are more common than fissure veins, owing to the fact that the original fissures were formed in the direction of least resistance, which was that of bedding. We see, then, that the difference between a fissure vein and a bedded vein consists in the fact that the former occupies a fissure cutting across the bedding planes of the surrounding rocks, while the latter occurs in a fissure formed between the stratified beds; the ores, in fact, having filled the space caused by the forcing apart of contiguous beds. Bedded veins of the type so well known in Bendigo and in other districts of Victoria as saddle reefs, differ from ordinary bedded veins merely in that, instead of lying in one plane, they occupy fissures that, owing to the bedding of the strata, have assumed a shape that in cross section has the appearance of a saddle (Fig. 1). The en-

Fig. 1.

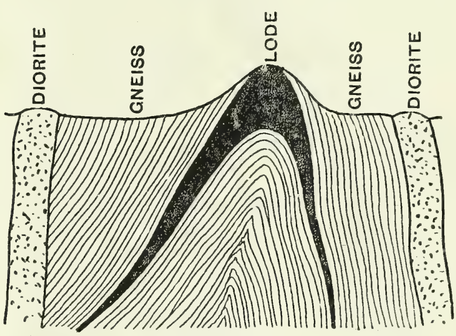


BENDIGO

closing rock at Bendigo consists of contorted slates and sandstones of Lower Silurian age. The contortions have assumed the shape of troughs and saddles, just as a quire of paper will, if lateral pressure be exerted. The process was beautifully illustrated in Mr. H. M. Cadell's ingenious experiments. The apparatus he used was a strong wooden box, in which pressure was applied to a removable end by means of a screw. The strata were subjected to no load but that of their own weight, and the conditions of the experiments were such as to represent those of rocks at or near the earth's surface. The contortions of the Bendigo rocks were obviously produced in an analogous manner. It is of interest to note that while the sides of the saddles invariably thin out and disappear in depth, the permanence of the mines is assured by the certainty of other saddles being found almost perpendicularly under the first.

The great silver ore deposit at Broken Hill, New South Wales, which, until it was investigated by Mr. E. F. Pittman and Mr. J. B. Jaquet, was thought to be a true fissure vein, is really similar to the saddle reefs of Bendigo. The Broken Hill district is composed of similar contorted rocks, chiefly crystalline gneisses. Broken Hill itself is formed by a saddle of rock, the highest part of the ridge being occupied by the outcrop of the vein, while on the eastern and western slopes the gneiss dips east and west respectively. If, therefore, the Broken Hill lode is, as it appears to be, a huge saddle vein, the eastern and western sides may be expected to thin out in depth, a possibility happily not a matter for immediate alarm, and probably other similarly shaped veins will be found below the Broken Hill lode. (Fig. 2.)

Fig. 2.



BROKEN HILL

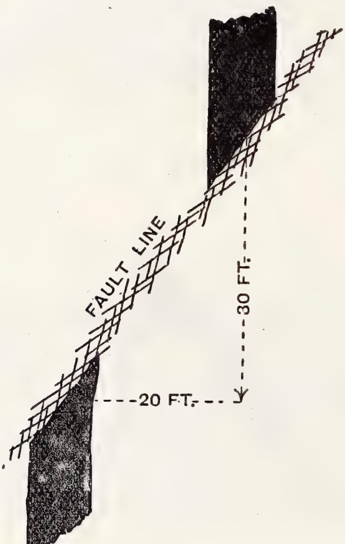
When a mineral vein occurs at the planes of contact of two dissimilar rocks, it is known as a contact vein. Such deposits present many points of resemblance to bedded veins. Notable examples of contact veins are afforded by the series of silver deposits at Leadville, Colorado.

When a vein is intersected by a fissure or by a vein of more recent age than itself, a fault or displacement often results. Generally the portion of the ground on the upper side has shifted downwards. This rule, however, is not without exceptions, especially when the strata are much contorted. Fig. 3 (p. 676) represents a reversed fault at the Great Boulder mine in Western Australia. When several faults dislocate veins one after another, great complications may result. The appearance

of such faults in plan is illustrated in Fig. 4. In this case the Eva vein at the Menzies Consolidated Gold Mines in Western Australia is seen at the 425-foot level to be faulted at several points along its course. The vein (shown black) is 3 feet wide, and contains 1 oz. 2 dwt. of gold per ton. The adjoining dotted portion is the altered enclosing rock impregnated with gold quartz. This is 35 feet wide, and contains 8 dwt. of gold to the ton.

No known mineral vein is composed solely of the ore worked. As a rule the greater proportion of the contents consist of veinstone, of which quartz is the most common. A typical example of a vein is shown in Fig. 5, from a

FIG. 3.

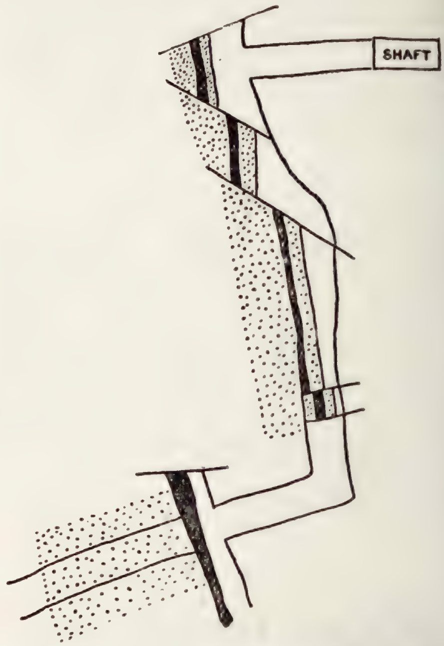


REVERSE FAULT. GREAT BOULDER MINE.

drawing by Professor Le Neve Foster, representing a lead vein in slate, at Wheal Mary Ann, Cornwall. In this case the fissure has been filled up by the successive deposition of bands of mineral (chalcedonic quartz, vitreous quartz, galena and spathic iron ore) on both sides.

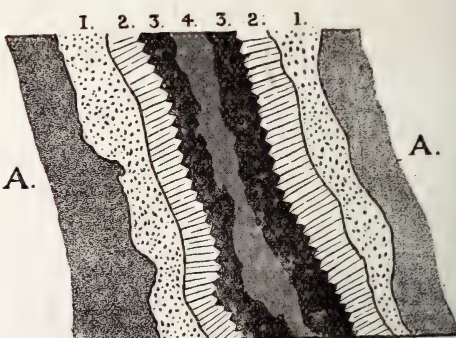
In almost all cases the outcrop and upper portions of veins have been acted upon by atmospheric agencies, the iron pyrites in the vein having been converted into peroxide of iron. This gossan, as it is called by the Cornish miners, or iron hat (*eiserner Hut*, *chapeau de fer*), as it is called by their Continental comrades, is observed especially in silver and copper veins, in which at greater depths sulphide ores are encountered, and was formerly regarded as an infallible criterion of the value of the vein. The extensive deposits of brown iron ore above the copper deposits at Rio Tinto and Tharsis in Spain, and the remarkable sinter-like capping of the Mount

FIG. 4.



Morgan mine in Queensland, are probably results of the surface alteration of the deposits. In gossans of gold and silver veins a concentration of the valuable constituents is generally noticed, and in many cases the surface oxidation benefits the miner by supplying

FIG. 5.



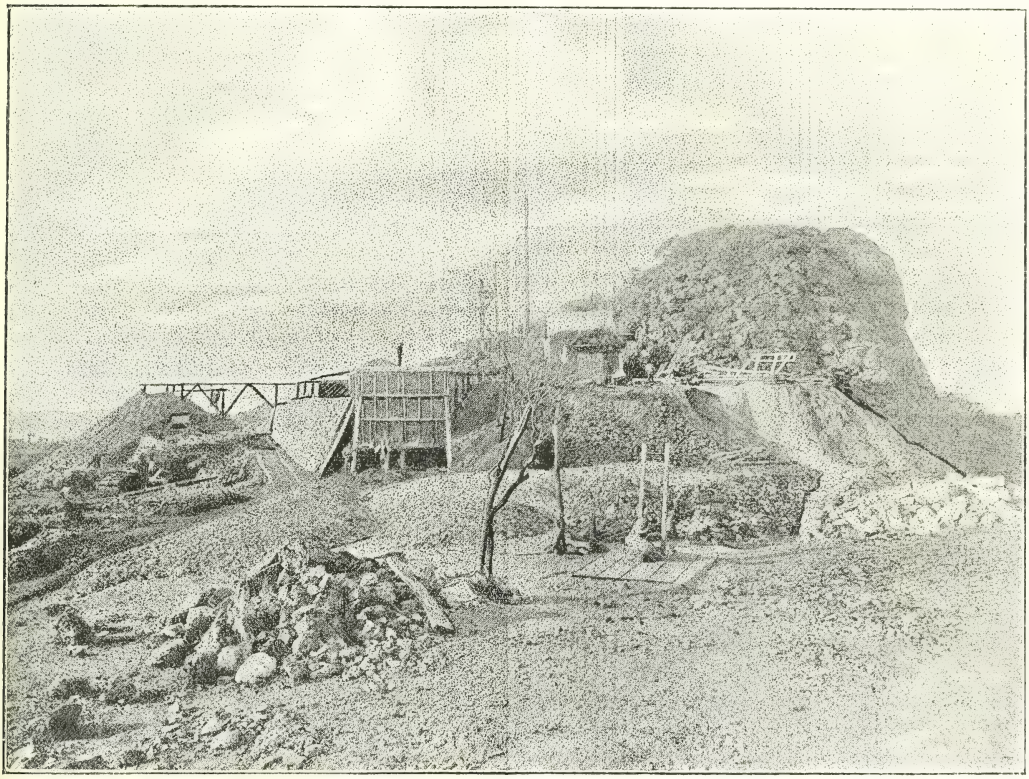
ing him with an easily reducible ore in place of a refractory sulphide. This was notably the case at the Broken Hill silver mines, New South Wales, where the ferruginous outcrop

was a striking feature in the landscape (Fig. 6).

In veins it is usual to find that rich portions alternate with poor. As the ore is not uniformly distributed through the mass, it is well to show this on the mine plans; and the vertical projection of the workings may with advantage be made to show much more than the amount of work done and of ore excavated. Contour lines from level to level may be plotted exhibiting the number of units of value of ore existing, provided that sufficient details of vein width and of assay values are available. Surface cost and general charges are usually expressed per unit of weight of ore milled; but by the aid of an ingenious slide rule invented Mr. J. C. Little, these costs can be distributed over the area worked, and the total cost per square unit recorded. It is convenient to distinguish five classes of ground, namely, barren, poor, payable, profitable, and rich. Distinctly coloured on the section, this classification enables the character of a mine to be seen at a glance.

The productiveness of a mineral vein is influenced by various conditions. Experience shows that rich accumulations occur at the intersection of one vein with others. The parts of a vein approaching the vertical are often richer than those that are nearly horizontal. Lastly the nature of the enclosing rock has a marked influence on the ore contents of the vein. A few examples may be cited. The Freiberg veins are rich in grey gneiss and poor in red gneiss. In the lead mining districts of Great Britain the veins are wide in limestone and narrow in sandstone and slate. In the Lake Superior copper district, the veins are rich in amygdaloid rock and poor in diorite and sandstone. The veins of Kongsberg in Norway contain silver only when they traverse certain grey schistose beds. In Victoria, Queensland, and New Zealand there are marked beds of rock in which the gold veins are richest. Their influence is so well known in the Ballarat field that these beds are termed "indicators."

FIG. 6.



OUTCROP AT BROKEN HILL.

The origin of mineral veins is a much de-

bated subject that has long occupied the attention of geologists. All the theories that have from time to time been propounded assume in the first place that a fissure has been formed in the earth's crust. This fissure has, it is thought, been filled up (1) by mechanical action causing the attrition of the sides, (2) by injection of molten or plastic material from below, as in the case of dykes of eruptive rock, (3) by the action of electric currents on metallic salts dissolved in the waters traversing the fissure, (4) by aqueous deposition from above, (5) by sublimation, (6) by lateral secretion, that is by deposition from solution from the sides, or (7) by ascension or deposition from solution from below. The first four theories have now been generally abandoned. In the case of the fifth theory, it is probable that, although sublimation may have helped in the impregnation of rocks by mercury and tin ores, its action was, in most cases, of secondary importance. The sixth, or lateral secretion theory, received great support from the researches of Professor F. Sandberger, who, having detected the presence of copper, tin, lead, zinc, cobalt, and nickel in silicates (mica, augite, and olivine), which occur as component minerals of the commonest rocks, concluded that these metals had been dissolved out and deposited in fissures. Sandberger's theory has been adopted to a certain extent by many eminent American geologists, notably by S. F. Emmons, W. P. Blake, A. Winslow, J. Le Conte, and G. F. Becker. On the other hand it has been warmly contested by A. Stelzner and F. Posepny.

The seventh theory, that the filling material has been derived from greater depths by solvents circulating through the fissure, has been advocated by Newberry, Posepny, R. W. Raymond, and by Dr. John R. Don, of Otago, New Zealand.

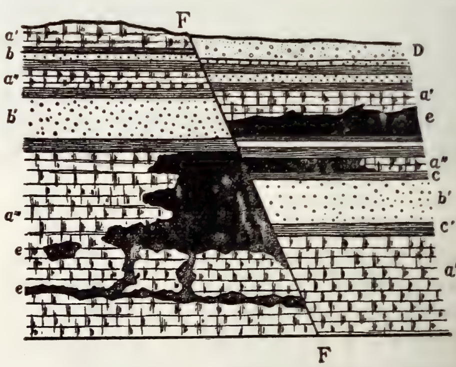
A mineral vein in process of formation in accordance with this theory may be seen in the case of a thermal spring near Teplitz, in Bohemia. Owing to the flooding of adjacent brown-coal mines, this spring was examined, and the sides of the fissure were found to be coated with heavy spar, the deposition of which was still in progress. The spring must have been active for a very long period, and yet the fissure was not filled up, thus showing the great length of time that may be required to fill a fissure with mineral constituents.

The chief point brought out in all recent investigations is that, in most cases, the deposits have been formed through molecular substitution and replacement by mineral-bearing solutions following the easiest channels of approach.

MASSES.

Whereas beds and veins are tabular in form, masses are of irregular shape. In some cases deposits of this class, consisting of rock with disseminated iron ore, are of such vast dimensions that entire mountains of iron ore result. As examples may be mentioned the deposits of Gellivare and Luossavaara in Sweden, of Gora Blagodat in the Ural, and of the Styrian Erzberg. In this class, too, it is convenient to include the huge copper pyrites deposits of Rio Tinto and Tharsis in Spain, of Mount Lyell in Tasmania, of Ducktown in Tennessee, of the Rammelsberg in Germany, of Falun in Sweden, and of Sudbury in Canada. There are numerous illustrations of this class of deposit occurring in limestone. Such, for example, are the silver-lead deposits at Laurium in Greece, and in Missouri; the zinc deposits of Carinthia, of Upper Silesia, of Santander in Spain, of Altenberg near Aix-la-Chapelle, of Sardinia, and of Lombardy; the silver ore deposits of Nevada and Utah. The Cumberland red hæmatite deposits are the best known typical examples of this class. The ore is thought by Mr. J. D. Kendall, who has carefully investigated the district, to have been formed by the replacement of the limestone by solution of iron, the existence of which he connected with volcanic agencies. Fig. 7 is a reproduction of a section drawn by Mr. Kendall of the iron ore mass at Wyndham pit.

FIG. 7.



F, fault; *a*, limestone; *b*, sandstone; *c*, shale; D, boulder drift; *e*, hæmatite.

Some of the world's greatest gold mines at the present time are working auriferous masses. This is the case at the Mount Morgan mine in

Queensland, and at the Treadwell mine in Alaska. A good example is afforded by the Sheba mine in the Transvaal, which has been in operation for 14 years. The mass of gold quartz is 50 yards long, and its width has not yet been fully ascertained.

Under the head of masses it is convenient to include that class of deposit to which German miners have given the name of Stockworks. In these the mass consists of rock traversed by innumerable small reticulated veins which render the whole workable. Typical tin deposits of this class are met with in Cornwall and in Saxony.

Classification of Ore Deposits.

Hitherto I have contented myself with merely dividing ore deposits into the three great groups of beds, veins, and masses. If, however, ore deposits are to be classified with greater precision it is necessary to consider the distribution of the elements in the earth's crust. Valuable information on this point has been furnished by Professor Vogt, of Christiania, who finds that the percentage composition of the earth's crust is as follows:—Oxygen, 47·2; silicon, 28·0; aluminium, 8·0; iron, 4·5; calcium, 3·5; magnesium, 2·5; sodium, 2·5; potassium, 2·5; manganese, 0·075, and nickel, 0·005, together with smaller proportions of tin, cobalt, zinc, lead, copper, silver, and gold. Excepting iron and manganese, the heavy metals comprise about one-hundredth per cent. of the solid crust of the earth. The methods in which these metals have been concentrated has furnished Dr. G. Gürich, one of the most recent writers on the subject, with a rational basis of classification to which I shall subsequently refer.

In place of this long list of constituents, the earth's crust was thought, according to the oldest classification, to consist of two substances, the marketable and the unmarketable. Unfortunately this kind of primitive geology is often still to be found among mine managers, whose views on the occurrence of ore are represented by the maxim: "Where it is, there it is!" The classification of ore deposits into veins, beds, and masses, a classification which is sufficient for practical mining purposes, was, however, indicated in Georgius Agricola's great work "De re metallica," the oldest systematic treatise on mining, published at Basel, in 1556. He discusses the origin of ore deposits in another work "De ortu et causis subterraneorum," published in 1546, in which he distinguishes veins (*venae*), strings (*fibrae*), and fissures (*commissurae*), beds (*venae dilatatae*), and masses (*venae cumulatae*). The author of this classification died in 1555. The influence of his works on his contemporaries and on their successors up to the beginning of the present century cannot be over-estimated. He it was who first brought mining into the category of the exact sciences. The dedication of a work published by him in 1545 to the Elector Maurice of Saxony, is clear evidence that he lived only for his science. "My needy circumstances," he wrote, "have not allowed me to incur great costs on my writings, as emperors, kings, and princes can do. Some expense I have, however, incurred, and my income has been not a little diminished by it. By devoting myself with all my soul to the study of nature, I have taken no thought of my fortune, which I might honourably have much increased if I had thought more of riches, possessions, and posts of honour, than of the knowledge of unknown things and of the study of nature." *

In the present century the schemes of classification suggested have been very numerous and varied, and reference may be made to some of the suggestions that have received the greatest favour. In 1855 the French geologist, Burat, proposed the following classification, based on the form of the deposits:—

I. Regular deposits: veins.
II. Irregular deposits: (*a*) contact deposits, (*b*) eruptive veins and masses, and (*c*) metamorphic deposits.

Under the head of contact deposits he included the Rammelsberg ore bed, and under that of metamorphic deposits, the Mansfeld seam of copper shale.

A marked improvement on this classification is shown in that suggested by the German geologist, B. von Cotta, in 1853, whose scheme, also based on the form, was as follows:—

I. Ore beds: (*a*) parallel intercalations, (*b*) surface deposits.
II. Ore veins: (*a*) transverse veins, (*b*) bedded veins, (*c*) contact veins, (*d*) lenticular veins.

* "Etsi vero tenues meae facultates non ferebant, ut in eas res de quibus scripsi magnos sumptus facerem, quos soli imperatores, reges, principes facere possunt, tamen aliquos feci familiaris non exiguam facturam. Dum enim toto animo acrius in haec studia incumbo, abjeci curam reram privatarum, quas honestis rationibus multum potuissem augere, si vel divitias, vel opes, vel honores majoris aestimassem, quam cognitionem rerum occultarum contemplationemque naturae" (De natura eorum quae effluunt ex terra. Basel, 1545.)

III. Masses: (*a*) vertical masses, (*b*) horizontal masses.

IV. Impregnations: (*a*) independent impregnations, (*b*) dependent impregnations (connected with other deposits).

In this classification the ore beds and ore veins received equal attention. Grimm, in 1869, followed the same general plan, except that he brought into greater prominence the class of impregnations disseminated through rocks. Callon, Professor C. Le Neve Foster, and other writers on mining, content themselves with the three divisions—beds, veins, and masses.

A more elaborate classification was that adopted by the late John Arthur Phillips in his treatise on ore deposits (1884), a work in the compilation of which it was my privilege to share. His classification is as follow:—

I. Superficial: (*a*) deposits formed by the mechanical action of water, (*b*) deposits resulting from chemical action.

II. Stratified: (*a*) deposits constituting the bulk of metalliferous beds formed by precipitation from aqueous solutions, (*b*) beds originally deposited from solution, (*c*) ores disseminated through sedimentary beds, in which they have been chemically deposited.

III. Unstratified: (*a*) true veins, (*b*) segregated veins, (*c*) gash veins, (*d*) impregnations, (*e*) stockworks, (*f*) fahlbands,* (*g*) contact deposits, (*h*) chambers or pockets.

This classification differs from the older systems in that it is based chiefly, not on morphological but on genetic characteristics. Its drawback is that the third division contains so heterogeneous a collection of deposits that no common property is to be found apart from that expressed by the negative distinction of being unstratified.

A natural classification of ore deposits based exclusively on genetic characteristics was that proposed in 1878 by Dr. A. von Groddeck, of the Clausthal School of Mines. He distinguished:—

I. Original or primary deposits. A. Contemporaneous with the surrounding rock, (1) deposits in stratified rocks, (2) deposits in eruptive rocks. B. Later than the surrounding rocks: (1) deposits filling pre-existing cavities, (*a*) veins, (*b*) cave fillings; (2) metamorphic deposits.

* A modification of fissure veins occurring in Norway.

II. Secondary or detrital deposits.

The advantages of this classification are that cognisance is taken of the mode of formation of the deposits, and that the existence is admitted of ore deposits of later formation than the surrounding rock that do not necessarily fill pre-existing cavities or fissures.

In 1880 Professor F. Posepny, of the Przibram School of Mines, proposed an essentially genetic division of ore deposits into (1) deposits in pre-existing cavities, and (2) deposits formed by gradual replacement of the rock substance by the vein material, the first class of deposits being further subdivided into those filling cavities formed in a mechanical way, or dislocation spaces, and those formed by corrosive action, or corrosive spaces.

In 1882 Sir Archibald Geikie adopted the following classification:—

I. Contemporaneous ores of stratified rocks.

II. Contemporaneous ores of crystalline rocks.

III. Subsequently introduced ores: (1) veins, (2) masses and stockworks.

This classification has the merit of conciseness, and the principal divisions are based on genetic principles.

Purely genetic systems of classification have also been elaborated by Professor H. S. Monroe and by Professor H. F. Kemp, of the New York School of Mines, in 1892. The former classifies mineral deposits of all kinds, whether metalliferous or not, into the following divisions:—

I. Beds of surface origin: (*a*) mechanical, (*b*) chemical, (*c*) organic, (*d*) complex.

II. Deposits of subterranean origin: (*a*) filling fissures and cavities formed mechanically, (*b*) filling interstitial spaces and replacing the walls.

Kemp's system is somewhat similar. He adopts a genetic classification in three divisions:—

I. Deposits of eruptive origin, the so-called magmatic deposits.

II. Deposits formed by deposition from solution.

III. Residual deposits formed from suspended heavy particles, *e.g.*, magnetic sands.

The classification adopted by Professor Henry Louis (1896) in his edition of Phillips' "Treatise on Ore Deposits" is in two great divisions—(1) deposits formed contemporaneously with the surrounding rock, and (2) those introduced subsequently. This distinction he expresses by the words "symphytic

and "epactic." The two main classes are subdivided in the following manner:—

I. Symphytic deposits: (*a*) fragmental deposits, (*b*) precipitates from aqueous solution, (*c*) deposits from solution subsequently metamorphosed, (*d*) disseminations through sedimentary beds.

II. Epactic deposits: (1) veins, comprising (*a*) fissure veins, (*b*) bedded veins, (*c*) contact veins, and (*d*) gash veins; (2) masses, comprising (*a*) stockworks, (*b*) massive deposits in limestone, (*c*) massive deposits connected with igneous rock, and (*d*) disseminations in igneous rocks.

As a compromise between the morphological and genetic systems, this classification is well adapted to practical requirements; at the same time the probable origin of the various classes of deposits is not lost sight of.

An ingenious classification has recently (1897) been proposed by the Austrian geologist Hoefer, in which he takes into account the relation of the deposits to the surrounding rocks, and at the same time attempts to systematise the nomenclature of ore deposits. His classification is given in the accompanying Table.

Dr. G. Gürich, of Breslau, the latest investigator of the subject (1899), uses the mode of concentration as the basis of classification. The concentration may take place with or without a change in the state of aggregation. In the former case the passage into the solid state is from a state of vapour, from a molten state, or from a state of aqueous solution. Consequently the following classes of ore deposits are distinguished:—

I. Sublimation deposits: (*a*) syngenetic, in which the sublimation of the vapours takes place simultaneously with the solidification and within a solidifying magma, *e.g.*, tin ore deposits; (*b*) epigenetic, in which crusts are formed coating fissures; (*c*) metagenetic, in which the constituents of a rock are dissolved by pneumatolysis and replaced by metallic substances.

II. Magmatic, or solidification deposits: (*a*) syngenetic, representing the usual form of magmatic deposit as described by Vogt; (*b*) epigenetic, only imaginable if an apophysis of a magma within the enclosing rock consists of a metallic band; (*c*) metagenetic, hardly imaginable.

III. Precipitation deposits: (*a*) syngenetic, in which chemical precipitation takes place simultaneously with sedimentation, the deposit being formed simultaneously with the surrounding rock, *e.g.*, seams, beds; (*b*) diagenetic, in which concentration takes place on the muddly floor of a lake, *e.g.*, concretionary nodules of clay iron ore; (*c*) epigenetic, in which the deposit is

HOEFER'S CLASSIFICATION OF ORE DEPOSITS.

In relation to the surrounding rock.		Origin of the deposit.	Size.	Form of the Deposit.			
				Flat.	Lenticular.	Irregular or equal in all directions.	Linear.
The Deposit may be	Contemporaneous	Sedimentary.	Large	Bed	Stratified mass	Stratified bunch	Stratified column or pipe
			Small	Seam	Lenticule	Stratified pocket	Stratified thread
		Eruptive.	Large	Eruptive sheet	Eruptive mass	Eruptive bunch	Eruptive column
			Small	Eruptive film.	Eruptive lenticule	Eruptive pocket	Eruptive thread
	Later	Filling cavities.	Large	Vein	Vein-like mass	Vein-like bunch	Vein-like column
			Small	String	Vein-like lenticule	Vein-like pocket	Vein-like thread
		Metamorphic.	Large	Metamorphic bed	Metamorphic mass	Metamorphic bunch	Metamorphic column
			Small	Metamorphic seam	Metamorphic lenticule	Metamorphic pocket	Metamorphic thread

formed subsequently to the surrounding rock, *e.g.*, veins, cave fillings; (*d*) metagenetic, in which the soluble constituents of a rock are dissolved, transported, and the metallic substance precipitated, the deposit being formed subsequently to the enclosing rock, but growing at the expense of the latter.

IV. Separation deposits: (*a*) residual deposits formed by chemical concentration, a soluble rock constituent, *e.g.*, lime, being carried away, and a metallic substance, *e.g.*, brown iron ore, remaining unaltered; (*b*) detrital deposits formed by mechanical concentration, *e.g.*, dry placers, alluvial deposits.

In view of the apparent impossibility of definitely determining the genesis of a given deposit, it may be questioned how far it is advisable to adopt a genetic classification. Probably, however, by employing such system of classification, an observer would be induced to make a more thorough examination than if he were required merely to define the deposit by its outward form. Any efforts to introduce improvements in mining must, however, subordinate theory to practical requirements.

Mining Methods.

In consequence of the difference of form in beds, veins, and masses, various methods of working have to be employed. In the case of beds it is desirable to make a hole of the least possible depth from the surface to the ore. A shaft is therefore sunk through valueless beds until the ore is reached, when the main roads required for transport are driven. The actual modes of working, although varying greatly in different districts, may broadly be divided into (1) the pillar and stall method, where the first stage of excavation is accomplished, with the roof supported by pillars of ore, and (2) the long-wall method, where the whole of the roof is allowed to settle behind the miners, no sustaining pillars being left. In most cases the excavations from which the ore has been removed are filled with waste material in order to lessen the subsidence.

The method of working veins, which are usually highly inclined, differs greatly from that followed in the case of the more or less horizontal beds. Horizontal galleries, termed levels, are driven from the main shaft upon the vein, usually 60 feet apart. These are connected by means of small shafts termed winzes. Projected on a vertical plane, the vein will thus be seen to be cut up into pillars and to resemble the appearance in plan of a bed worked by the pillar and stall method. These pillars are usually worked away by miners standing on timber platforms breaking down the mineral above them, a process known as overhand stoping. In the old days the miner worked away the ore beneath him in a series of underhand stopes. In cases where the contour of the ground allows it, tunnels or adit levels are driven on the vein or to cut it. This procedure is much cheaper than sinking a a shaft.

Masses are in some cases worked like veins. Usually, however, if the enclosing rock is strong, chambers are worked out, filling up being unnecessary. In other cases, the mass is worked by horizontal slices, either taken in descending order, the surface being allowed to cave in, or taken in ascending order, the excavations being completely filled in with worthless material.

These are the chief forms of underground works employed for the different classes of deposits. Whilst of late years great progress has been made in the introduction of mining machinery of greater precision and power, and in the enlarged scale on which mining operations are conducted, the general principles of the methods of working have changed but little since the introduction of gunpowder as a blasting agent in 1620. Previous to that date, as we learn from ancient records and from the works of Agricola, the implements used were of the nature of picks or wedges and hammers. Bit by bit pieces of rock were broken away, the operation being aided by natural fissures and by the brittleness of the rock. In this way the ancient miners cut coffin-shaped galleries 5 feet in height. In some cases recourse was had to fire to make the rock split and crack. This ancient process of fire-setting is not quite obsolete. Some years ago I saw it in use at Kongsberg, in Norway, and it is still used by the gold miner in Siberia and on the Klondike to soften the frozen ground preparatory to sinking a shaft. In Agricola's time water-wheels or tread-wheels were used for supplying the power for raising the ore, and ventilation was effected by shaking cloths. Still, with these primitive appliances, great depths were attained and large amounts of ore extracted.

The methods of mining in vogue in the 15th century are well shown in the chased silver ceremonial collar of the Master of the Goldsmiths' Company at Ghent. In the first panel the use of the compass in surveying mines is

depicted, and the other panels illustrate the operations of preparing the mine timber, breaking, tramming, and carting the ore.

An interesting picture of the method of mining employed at this period is afforded by a medal struck in 1680 of silver obtained from the St. Anna mine at Freiberg, in Saxony. On the obverse (Fig. 8), the mine is shown in section below a hilly district with, on the right, a horse-whim and mine buildings, and on the left a shaft with a hand windlass. In the winding shaft on the right ore is being raised by a chain, and on the left there is a pumping shaft with double lifts of pumps and a ladder-way. Further to the left a path leads to another shaft. At the bottom of the mine six men are engaged in underhand stoping. The mine timbers are well shown throughout. The reverse gives a picturesque view of the vicinity, showing the manner in which water-power is carried to the mine.

FIG. 8.

The methods of mining in vogue at the Falun copper mine in Sweden, at a somewhat later date, are shown on the silver medal struck in 1755 to commemorate the visit of King Adolphus Fredrik and his consort underground. On the obverse are profile busts of the King and Queen, with the inscription ADOLPH. FRID. ET LUD. ULR. D.G. REX ET REG. SVEC.; and on the reverse a section of the Adolf Fredrik shaft and the Queen Luisa Ulrica mine. At the surface the mine buildings, horse-whim, pump rods, &c., are shown. Below the section of the workings there is the device of the mining company (a mountain with a timbered shaft, and above it the alchemical symbol for copper, intersected by two arrows), with the inscription, MAGNUM CUPRIM. D. XXI. IUN. MDCCLV. The inscription at the top of the medal is COMINUS LUSTRANT SUPERI.

In England, too, ancient records throw light on the early methods of mining. A charter dated 1408 exists in which the "Myne deeps," as they were then called, are quaintly represented. The chief mines are correctly shown in the plan, and marginal drawings convey a good idea of the mining methods in vogue at that date, whilst a drawing of a huntsman with hounds is introduced to signify that the Mendips were a royal chase preserved by Edward IV. The heraldic crest on a brass of the 15th century in Newland Church represents the Forest of Dean iron miner of that period equipped for his work. He is represented wearing a cap, bearing on his back a wooden hod, carrying in his right hand a small pick, and holding a candlestick between his teeth. A similar method of lighting is used in many mines in South America. A stick is cleft at one end to receive the candle, which is fixed in a vertical position.

The introduction of gunpowder as a blasting agent changed the conditions in which mining had previously been carried on, and the invention of the steam-engine rendered

it possible to attain depths previously undreamed of. The greatest progress has, however, been made in this century, when with the aid of dynamite and other high explosives, of wire rope, of compressed air rock-drills, of electric light and power, and of improved pumping, winding, and ventilating machinery, it has become possible to extract ore with profit—as the Calumet and Hecla mine in the Lake Superior district is doing—from a depth of nearly 5,000 feet.

Underground mining is not necessary with all ore deposits. In some cases the excavation is open to the sky. In the iron ore beds of Northamptonshire, for example, the overburden is removed from the ore which is broken down with the pick and loaded into waggons. At the Rio Tinto copper mine, at the iron mines of the Styrian Erzberg of northern Sweden, and of the Ural, at the Mechernich lead mine, and in many other instances, the ore is obtained in a huge open pit from a series of terraces. At some of the iron mines of the Mesabi range, Lake Superior, great economy and speed are obtained by the employment of steam shovels for removing the ore and loading it into railway waggons.

The alluvial beds of river gravel containing gold are also worked open-cast. The deposits are excavated when the river is low, or the river is diverted for the purpose. The auriferous material, having been dug up with a pick and shovel, is washed on the spot in a circular tin pan or wooden batea. Reference to Agricola's book shows that the pan was used for this purpose in very early times. For working on a larger scale the cradle and sluice-box are used.

In the gold-fields of West Australia the absence of running water renders such appliances unavailable, and the concentration is effected by a process of dry blowing, in which wind replaces water. The method, as described and illustrated by Mr. T. A. Rickard, is simple. Taking two pans, the miner places one of them on the ground empty, while into the other he puts a shovelful of auriferous sand. The material is shaken up so as to bring the big lumps on top, and then resting the pan on one knee and holding it with the left hand, the miner uses his right hand to skim off the coarse particles. Then standing up, facing at right angles to the wind, he slowly empties the full pan into the empty one at his feet. As the stream of sand falls, the wind blows away the fine material in a cloud of dust. The material is further concentrated by tossing it up and down in the pan. Then giving the pan a circular motion the miner again skims off the lighter particles, leaving about half-a-pint of dry material, which is further diminished by panning just as in water. Finally he drops on his knee, and, holding the pan so that it is tilted forward, raises it to his mouth and completes the process with his breath. The rapidity and completeness of the operation depend on the strength and uniformity of the wind. Machines of several types, in which the material is subjected to a shaking movement in a current of air, are now largely employed.

In California, in British Columbia, in New Zealand, and in other parts of the world water is often used for breaking down auriferous gravel. This method, known as hydraulic mining, consists in the disintegration of auriferous gravel deposits by propelling a heavy jet of water under pressure upon the bank, and in washing the gravel down through sluices in which mercury is distributed. The gold forms an amalgam and is thus caught. The method was introduced in California in 1856, although its origin is much older, as Pliny describes a somewhat similar system of hydraulic mining in Spain. Hydraulic mining has given rise to an extensive system of artificial reservoirs in California for the storage of water, and to the construction of artificial water courses to convey the water thus stored to the scene of mining operations. These canals, or flumes as they are locally termed, are carried for miles over deep gorges and along precipitous cliffs. A few years ago there were in California 6,000 miles of mining ditches, their estimated total cost being £3,000,000. Some of them were made at a cost of £5,000 per mile. The cost, too, of keeping them in repair is considerable, as the hydraulic miner has constantly to contend with the elements—frost and flood, ice and snow, wind and rain. As a typical illustration of this method of mining, I may cite the operations of the Cariboo Hydraulic Company in British Columbia. The face of auriferous gravel attacked is 200 feet in height. Water is brought through 21 miles of mining ditches, which are 3 feet deep, 13 feet wide at top, and 7 feet wide at bottom. The nozzle, or monitor as it is called, through which the water under pressure is delivered, is 10 inches in diameter; the water being conveyed from the ditches through steel pipes decreasing from 48 inches to 22 inches in diameter.

When we remember that mines such as that

at North Bloomfield, California, consume daily more than 33,000,000 gallons of water, enough for a town of 350,000 inhabitants, it is not astonishing that some £100,000 may have to be spent on the water supply before any gravel is washed. In the case of the North Bloomfield mine, the actual amount of gravel removed was probably 7 acres 300 feet in depth.

Of late years very successful results have been obtained by extracting auriferous gravels from the beds of rivers by dredges. The practice of dredging originated and has been brought to its present state of perfection on the Clutha river, in the province of Otago, New Zealand. Ground containing only a grain or a grain and a half of gold per cubic yard can now be worked at a profit. The remarkable yield of a dredge working at Cromwell, on the Clutha river, which cost £5,000 to build and launch, and obtained more than that amount of gold within seven weeks after starting, shows how quickly the capital sunk in the industry has in some instances been returned. Experience in Montana, United States, shows that with a bucket-dredge 98 per cent. of the gold in the gravel is extracted. The cost of dredging when steam is employed is 4½d. per cubic yard, and when electricity is employed for power 2¼d. per cubic yard. The practice of dredging is coming into increasing use in New Zealand, Canada, California, Montana, the Republic of Colombia, and elsewhere. It represents an important advance in the working of alluvial deposits, and if the yields of gold in the future are not likely to be so sensational, they will probably be more regular than they have been in the past.

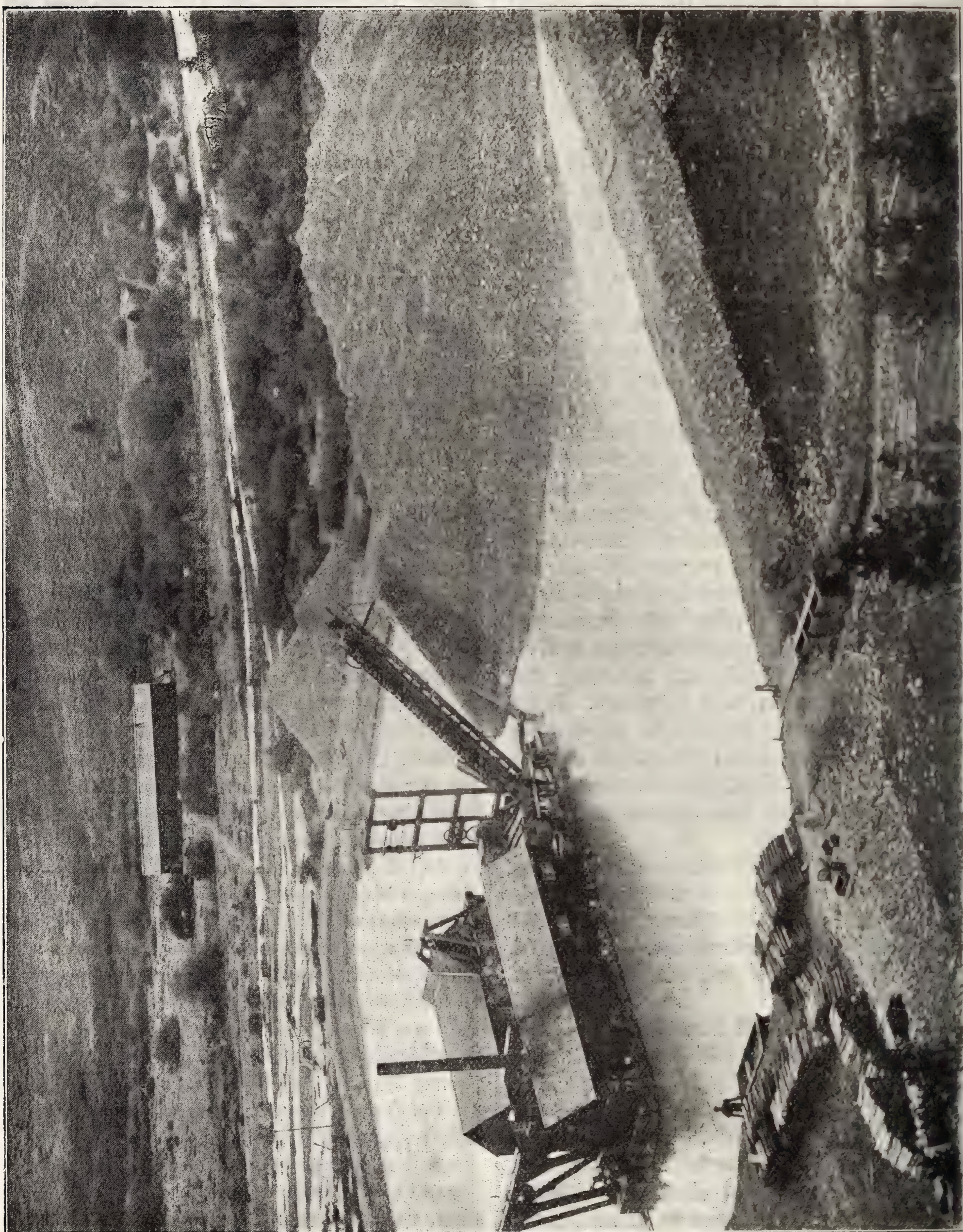
The accompanying illustration (Fig. 9, p. 686), shows the latest type of gold dredge made by the Risdon Ironworks of San Francisco. As represented it is excavating auriferous gravel 45 feet below the water, and stacking it 24 feet above.

These brief notes will, I hope, serve to give some idea of the manner in which the various classes of mineral deposits are worked, and to explain some of the technical terms frequently met with in mine reports. A report on a mining property should set forth clearly details of its position, means of access, fuel, water and timber supply, amount of development, and the character, value, and form of the ore deposit. It should be written in so lucid a manner as to be intelligible to the educated shareholder. Unfortunately this is not always done. Many so-called eminent experts, who have never been heard of before except by the vendor of the property, have been known to fill their reports with a bewildering mass of abstruse technicalities and theories. Mr. Walter McDermott cites a report which started with the nebular hypothesis, and traced the progress of the earth from its pulpy state through its various stages to oxidation of the outcrop of a particular vein in the year in which the report was written. These details were so full that there was no room left for anything but a very brief treatment of the merely commercial question of the value of the mine. In mining reports the indiscriminate use of technical terms and of local slang is undesirable and unnecessary. Indeed Prof. C. Le Neve Foster has shown us that it is even possible to write an exhaustive text-book on metal mining without employing provincialisms which vary from one district to another.

Great advances are being made in practical mining. Each year less money is wasted on hopeless undertakings; the well-trained mining engineer is replacing the storekeeper, accountant, architect, or what not, formerly so frequently found managing mines in newly developed districts; and the trammels of prejudice and rule of thumb are disappearing. There is, however, still room for improvement. How genuine mining enterprise may be encouraged and gambling avoided is a matter of great moment to the investing public. Mining differs but little from any other business, and is similarly governed by the rules of common sense, yet the shrewdest men of business will often trust a preposterous report, provided it is signed by a man who tacks on to his name the self-conferred degree of M.E. The author of "Baron Münchausen" was a mining expert of very questionable repute, and it is to be feared that famous romance has served as a model for many mining reports. Even when the expert is of unblemished reputation he has, in reporting on a property, to be on his guard against possible unscrupulous operations on the part of the vendors. An old device was to prepare the ground for the expert's examination by firing a blunderbuss loaded with gold dust at soft rock. Rock, too, has been broken down for him with the aid of dynamite cartridges containing gold dust, or his carefully selected samples have been saturated with chloride of gold. An elaborate example of mine salting occurred in Canada some years ago. Two accomplished swindlers purchased in Cornwall, from time to time, small parcels of tin ore, and shipped them to Toronto. Thence the ore was sent

surreptitiously to the west, and scattered about at the foot of a granite mass. This operation lasted 12 months. At the end of that time the extensive deposit of tin ore had been discovered, and application was made for the reward offered by the Government for a

Fig. 9.



Gold Dredge.

swindlers left the scene of their operations and disappeared for three years. Then suddenly it was announced in Quebec that an discovery of the kind. Experts were sent to inspect the mine and they confirmed the sensational discovery. A company was formed

to work the mines. The two swindlers sold their rights, accepted with thanks the Government reward, and disappeared for evermore. It is not surprising that the experts were misled, seeing that the ore was thickly covered with grass and moss. The imposture was finally discovered by an engineer who was sent to report on the property, recognising the ore as coming from a particular Cornish mine, and eventually the sale and transport of the ore were traced. This story shows how easily the most experienced mining men may be misled by the appearance of ore deposits. The study remains a perplexing one. Many facts are now established and much misconception removed; and it is perhaps not too much to hope that metalliferous deposits may at some future date be as well understood as seams of coal now are.

Miscellaneous.

ACTION OF LIGHT ON SILVER.

Although it is now about sixty years since Moser published the results of his experiments on the action of light upon various surfaces as revealed by the condensation of vapours upon them, the character of the change produced by light still remains a mystery. Theories have been suggested, guesses have been made, but little or nothing has been proved. Major-General J. Waterhouse, I.S.C., has, during the last year, accumulated some additional interesting facts in connection with this subject. He fully confirms Moser's results as to the production of a change on the surface of metallic silver by exposure to light that can be demonstrated by the condensation of a vapour, such as mercury upon it. But he has gone further, and demonstrated the change by the deposition of silver from solution, after the manner of the development of an exposed wet collodion photographic plate. By some half hour's exposure in bright sunshine "printed out" images were obtained, that is, images visible without any subsequent application of a developer. General Waterhouse shows that these results are not due to pressure against the mask or stencil plate used, nor to the emanation of vapours from it, nor to heat. Usually blue light gives a much stronger effect than red, but in one experiment when the exposure was for three hours to bright sunshine, the effect was reversed, and the patches under red, orange, and yellow glasses were developable, while those under the blue and violet glasses were not. But when the silver plate was heated to redness, quenched in dilute sulphuric acid, washed and dried, and the cut out design was also warmed before use, the effect produced by light was so small that it seems doubtful whether there was any effect at all. On the other hand, if the silver plate was exposed to the fumes of certain substances, especially nitric acid, it was rendered very much more sensitive. General Waterhouse, in his communication to the Royal Society, states that he hopes to continue the investigation this summer, and invites others to extend the observations that he has described.—*Nature.*

EXPEDITIOUS METHOD OF MAKING EMBANKMENTS.

The *Engineering Times* describes an expeditious method of making embankments, used in the construction of the Canadian-Pacific Railway, in places where abundant water-power was at hand, and also immense banks of gravel or morainic material. The water was brought down from the streams above under great pressure, and with it the gravel and boulders were washed into large sluices, which carried them to the points where the filling was to be done. The water was then allowed to drain away, leaving the gravel thoroughly settled in the new position. By means of logs laid in rows one above the other, the filling was confined within the proper limits, and thus the embankment rose, tier above tier, the slope being kept well within the angle of repose, and the logs soon sprouting and forming a network of roots, firmly binding the mass together.

Mountain Creek is the point at which a large amount of filling has been done on this plan in a most successful and economic way. Water is obtained from the creek some two miles above, and is led down in a flume, two feet high and four feet broad, to the flume-box, which is 206 feet above the railway track. From this point an iron pipe 14 in. in diameter, of 3-16ths inches thick metal, leads the water to the monitor, which is provided with nozzles ranging from 3 inches to 6 inches in diameter. The small-sized nozzles are used for breaking up the mass of gravel, while the larger ones furnish an increased volume of water to flush the sluices. Boulders 18 inches in diameter are readily moved without assistance, but two men with hooks are constantly on the look-out to clear any obstructions. The sluice, which has a grade of about one in ten, conveys the material beneath the railroad track and deposits it in a great pile at the centre of the area being filled. From this point it is gradually washed down until stopped by the row of logs at the edge, which, however, allow the water to flow off freely. The sides are made to slope at an angle of 37 degrees 40 minutes.

The cost of this filling is about one-half that of the ordinary way, but it is here carried on under great disadvantage. Not only must the work be entirely suspended between October and June, but the sluices and fixtures must be taken up in order to prevent wreckage by the avalanches, and so each spring the work must practically be constructed again. Nine men in all are required to conduct the filling: one at

the monitor, two to keep the sluices clear, and six to prepare and lay the logs at the edge of the filling, and to level off the material as it falls.

The total filling at this point will aggregate 300,000 cubic yards, of which 225,000 were put in place between June, 1897, and June, 1899, leaving but 75,000 yet to be filled.

MODERN ILLUSTRATION.

The *Pall Mall Gazette* of the 13th instant has the following article over the initials G. R. H.:—

The Board of Education has taken an excellent step in organising a loan exhibition of modern illustration. The collection will be confined to works specially invited; it will comprise typographical reproductions, with the original drawings, executed since 1860; and it will be opened to the public on the 15th of November next for a session of three months.

It is to be hoped that the public will respond to this admirable advance, and will try to learn something about illustration — especially about block-making—and so be in a position to appreciate the difficulties and the troubles of those black-and-white artists who are devoted to its service and who get little in return but ignorant criticism. For, in truth, the creation of a process block (not less than the old wood block) too often means the sacrifice of a work of art, so far at least as its reproduction and popularity are concerned. And what the block-maker leaves of the artist's idea is turned over to the diabolical ingenuity of the printer, to still further maim and disfigure. The South Kensington Exhibition does not go farther back than 1860, the best period of English illustration, when Millais and Sandys, Rossetti and Frederick Walker, with others as notable, drew upon the wood. It will therefore completely cover the transition period from wood to zinc, and when possible will show the original and the reproduction hanging together in one frame. It would be interesting in the case of illustrations done for newspapers and popular publications if the committee could add an ordinary print showing the exact state in which the drawing came under the eyes of the public. Many good designs are sacrificed every day to the breathless haste of ephemeral publications. Even our leisurely magazine and books suffer more from the printer than from the block-maker. To-day in London fine process blocks can be make to compare with the most exquisite American or French work, but they are never printed here as they are printed in the United States and in Paris. The artists in this country who are accused of producing slipshod "Impressionist" work turn out to be the finest craftsmen when they are printed in the American magazines. It is the fault of the paper-maker and the printer that we are being beaten out of the field in the production of fine process-block printing.

At the moment the black-and-white artists are deserving of all our sympathy, for their case is, indeed, a hard one. Although the publications multiply, the artist's fees gets each year nearer to the vanishing point, and to-day some of the cheap and popular magazines pay the magnificent sum of five to ten shlllings for a drawing which may have occupied the unfortunate craftsman from one to three days. By his brethren he is considered lucky even with work so ill-paid as this, for the great mass of the black-and-white artists are chronically without commissions of any kind. The truth is, of course, that the market is woefully overstocked, and the recruits come trooping in with every sunrise. South Kensington is partly to blame, but the cheap reproductive processes are the real offenders. With the perfection of these, publishers and editors flew to illustration, and for a time a small band of black-and-white men were able to make considerably more than their bread and butter. Parents and guardians eager to put their youngsters to some profitable occupation discovered, with wonderful unanimity, that the artist's profession was respectable, and straightway sent any youth or maiden who could draw a straight line to the Science and Art Schools to swell a profession which was already overflowing with mediocrity. It is not necessary to add that genius and even talent can command something more than five or ten shillings per drawing, but of talent at least there is still an ample supply in the profession. At present things are at their blackest. The beginning of the war last autumn gave work on illustrated newspapers and magazines to many who were in sore need of it. Now the interest has waned, and men whose industry and talent would have commanded success in almost any other walk of life are literally without means of support and do not know where to turn for the necessities of life. The moral of all this is obvious, and it should be well pondered before any youth is allowed to embark in the career of black-and-white art.

General Notes.

LIQUID AIR.—One of the greatest difficulties, says the *Engineer*, to be contended with in the practical applications of liquid air is that of keeping it for any length of time. According to Mr. Carl Linde, small quantities may be preserved in well-exhausted and silvered double-walled glass vessels for a relatively long time. One litre of liquid air requires for its evaporation in such a vessel about fourteen days. The ordinary sheet-iron vessels used industrially, holding about fifty litres, and covered with felt or wool, allow about two litres to evaporate hourly. Experiments are being made with a view of building large double-walled and silvered sheet-iron holders, and we may expect that holders will be constructed in which the evaporation will not be more than 1 per cent. per hour.

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FRIDAY, JULY 27, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

In future the Society of Arts Examinations will consist of Three Grades.

I. Preliminary or Junior.
II. General or Intermediate.
III. Senior.

It is not proposed to hold an examination in the Senior Grade in 1901.

Information respecting the Preliminary Grade and full Syllabuses will be found in the *Journal* for June 14 last. Separate copies of the Syllabus can be obtained on application to the Secretary.

The dates for the Examinations in 1901 are provisionally fixed for Monday, Tuesday, Wednesday, and Thursday, March 18th, 19th, 20th, and 21st.

The Programme for 1901 is now in preparation, and will be published as soon as ready.

The results of the Examinations held at the end of last March have been published. Copies of the list can be obtained at the Society's office, price 6d. each.

Proceedings of the Society.

CANTOR LECTURES.

THE NATURE AND YIELD OF METALLIFEROUS DEPOSITS.

By Bennett H. Brough.

Lecture II.—Delivered January 29, 1900.

Gold.

Gold, the metal to which I wish to direct your attention this evening, is undoubtedly the most widely sought product of the earth's crust. It was probably the earliest metal to attract notice, as it occurs in a native condition of a bright yellow colour, and is easily worked. The ancient Egyptians were acquainted with its use and worked extensive gold mines in Nubia. The character of these ancient mines is shown in a plan, drawn on papyrus 3,300 years ago, preserved in the Turin Museum. These mines were, as I have shown in a previous lecture,* the penal settlements of the ancient Egyptians, of which Diodorus Siculus, and Agatharcides drew harrowing pictures. As a medium of exchange gold was early used, the first coins having been made of nuggets of natural gold and silver alloy stamped officially on one side. They date back to 700 B.C. The history of mining shows us that in classic times the extraction of gold was carried on on the same principles as now obtain, the ore being pulverised, sifted, and the valuable portion obtained by washing in a current of water. This process was probably employed by Jason and the Argonauts for washing gold sands in Colchis, the stream being passed over fleeces, to which the heavy particles of gold adhered, while the lighter worthless sand was carried away. The details given by classical authors are, however, not very precise. Indeed, Herodotus, writing 450 B.C., was unable to record with certainty whence gold was obtained, but says he had been told that the Arimaspians, a one-eyed people, steal the gold from griffins.

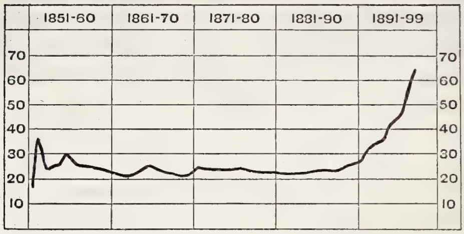
In the southern hemisphere traces of old civilisation have been found at Zimbabye in Mashonaland, where emblems of ancient worship and the moulds for gold ingots, of the characteristic knuckle-bone shape shown in the ingot of tin dredged up from Falmouth Harbour in 1811, point to a Phœnician origin. Archæologists tell us that the territories now known as Southern Rhodesia were, 2,900 years ago, a gold-producing country colonised by early Semitic races from round the Red Sea.

The importance possessed by gold in ancient times has not lessened at the present day. We have seen the annual production of the mines increase in a remarkable manner of late years, and there are no signs of any diminution in the supply excepting such as is caused by temporary disturbances, as in the case of the present war in South Africa. The gradual increase in the world's annual production (in

* *Journal of the Society of Arts*, vol. xl., 1892, p. 801.

millions of pounds sterling) is shown graphically in the accompanying diagram.

FIG. 10.



In 1898 the world's production of gold was greater than it had ever been. It was 21·1 per cent. greater than in 1897 and 36·9 per cent. greater than in 1896. A large share of the output is used in the arts, and another share goes into the war reserves accumulated by the great nations, so that only a moderate percentage of the total is available each year as an addition to the general stock of money. Geographically the production of gold is widely distributed. Indeed, there is scarcely a country in which some gold is not produced, though there are only a few districts in which it is abundant.

The world's production of gold in 1898 is estimated at £57,485,000, the share taken by the various countries being as follows:—

	Per cent.
Transvaal	27·6
Australasia	22·5
United States	22·1
Russia	8·8
Canada	4·8
Mexico	3·0
India	2·7
China	2·1
Other Countries	6·4
Total	100·0

The Transvaal, Australasia, and the United States, together produced over 72 per cent. of the world's supply. The world's production of gold in 1899 is estimated at £62,500,000, a record total specially remarkable in view of the stoppage in the working of the Transvaal mines during the latter months of the year.

Although the production of gold in the United Kingdom is trifling, a considerable amount of gold mining has been carried on in veins in the Silurian rocks of North Wales, notably between Dolgelly and Barmouth. Alluvial material has also been extensively worked for gold in Wicklow, Ireland, and in Sutherlandshire, Scotland. Many beautiful specimens of British gold may be seen in our museums. The deposits are, however, too irregular in their yield to be likely to prove the basis of a permanent industry. While the United Kingdom is poor in gold ore deposits it is satisfactory to note how large a proportion of the goldfields of the world are under British control. Of the world's gold production in 1898 the British Empire yielded 30 per cent.

Gold usually occurs in the native state. It is met with in veins, in beds, and in masses. The veins may cut through the rocks, or coincide with the bedding, or occur at the contact of two different rocks. The beds may be detrital, derived from the denudation of rocks containing veins of auriferous quartz, or conglomerates (as in the case of the "banket" beds of the Transvaal, and in that of the "cement" beds mined in Western Australia).

Veins of auriferous quartz rarely occur except in association with eruptive rocks, such as granites or dykes of diabase or diorite. So close is this association that it is thought by many that the eruptive rocks were the means by which the gold was brought up towards the earth's surface. If the eruptive rocks were not the source of the gold, it is probable that their extrusion afforded the heat that made the underground waters active in forming the deposit. Gold veins may occur in rocks of any geological age from the oldest up to those in course of deposition. Gold has been worked in rocks of eruptive origin. It has been found in recent lava, and its presence has been detected in sea water. It is therefore quite unsafe to prophesy, as has so often been done in the past, that any particular geological formation must necessarily be barren of gold. The principal gold veins may geologically be classified in the following manner:—

Rocks.	
Metamorphic	Nevada, Siberia, India.
Archæan	Canada, Brazil, West Africa.
Cambrian	Nova Scotia, Brazil.
Silurian	Victoria, Otago (New Zealand), French Guiana.
Devonian	Siberia, New South Wales.
Carboniferous	Gympie (Queensland).
Surassic	Mexico.
Triassic	California, Mexico.
Cretaceous	Dakota, Hungary.
Tertiary	United States, Australasia.
Eruptive	Hungary, Ural, India, Australia, Siberia, Borneo, Hauraki (New Zealand), Murchison (Western Australia).

The great alluvial deposits of the world are of newer Tertiary age. The great developments of gold mining, within short spaces of time, as in California and Victoria in 1849-52, and on the Klondyke, were due to alluvial mining. In Siberia, in the Yukon district, and in Guiana, almost the whole of the gold now produced is alluvial. The most common matrix of vein gold is quartz. Several other minerals are, however, found enclosing the native metal. The gold is often associated with sulphides, iron and copper pyrites, in which it is probably in a free state, but so finely divided that its extraction is difficult. It is evident, therefore, that the physical conditions in which gold occurs are variable. Large masses or nuggets are rarely found in veins. The famous nuggets, of which we see models in museums, were obtained from alluvial deposits in the early days of gold discovery in California and Australia. The largest, the Welcome Stranger, found near Dunolly in 1869, was 21 inches long and 10 inches thick. It weighed 2,280 ozs. The next largest, the Welcome Nugget, discovered at Ballarat in 1858, weighed 2,217 ozs. 16 dwts., and sold for £10,500. It was found at a depth of 180 feet, was much water-worn, and had attached to it about 10 lbs. of quartz and clay.

Fig. 11.

Gold Nugget.

Numerous theories have, at different times, been put forward to account for the formation of gold nuggets. Many authorities believe that they have been formed *in situ* in the alluvial deposits where they are found, and that starting with a nucleus they were gradually increased in size by successive deposits of gold from solution, or, in other words, that they were built up of superimposed coatings, and were analogous in structure to an onion. Careful experiments recently made by Professor A. Liversidge, of the University of Sydney, have, however, clearly shown that this ex-

planation is not justified. Gold nuggets were ground down or sliced through, and the sections thus obtained were polished and etched by means of nitric acid or other suitable solvent. As a result of this treatment, the professor found that the nugget did not present any trace of concentric coatings, but that the gold was always crystallised. In fact, the etched surfaces closely resembled those of meteoric iron, except in the form of the crystals. He further found that they usually enclose foreign substances (quartz, ferric hydrate, and clay), and also that a similar crystalline structure is shown by gold that has been melted. He does not think that native gold has necessarily been in a fused condition. His opinion is that it has been deposited from solution, usually within veins or pockets in rocks.

The most marked crystalline structure was shown by specimens from Western Australia where the gold is very pure, and where, owing probably to the dryness of that region, the nuggets are less water-worn than are large nuggets from other localities. A nugget from Coolgardie, Western Australia, examined (Fig. 11, p. 691) was internally practically free from foreign matter, and photographs of etched sections clearly show the crystalline structure.

Fig. 12.

Gold Nugget Section.

Fig. 12 is a photograph of an etched section taken very near the medium plane. A few minute cavities can be seen in the crystals. The dark portions are due to the way in which the light has been reflected from the surfaces of the crystals.

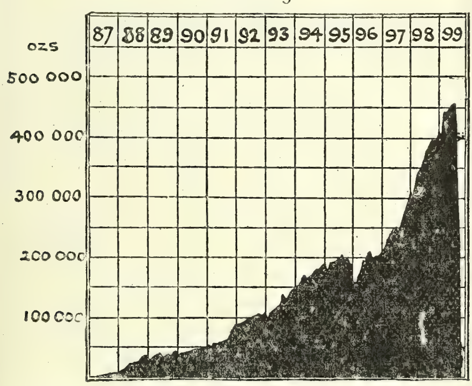
Africa.

Since the year 1888 the Transvaal has taken a prominent place in the production of gold, chiefly owing to the extraordinary results obtained in the Witwatersrand, a district which in 1898 produced more than any country in the

world. So fierce a light has recently been turned upon that region, so much has been written and spoken about its mines, that it is difficult for me to bring before you newer information or fuller details of the ore deposits, than are given in the description of a visit to these mines I read before the Society in 1893,* or in the various authoritative memoirs contributed by Mr. W. H. Penning† and others to the proceedings of the Society.

I will merely remind you that in the district the gold is obtained from beds, the whole of the metal being mined in the comparatively small area of about 100 square miles, extending 30 or 40 miles east and west of Johannesburg, with a width of two or three miles. From 1887, when mining began, to the beginning of the war in 1899, the district, which previously was a worthless area, hardly useful even for pasturage, has produced over 20,000,000 ozs. of gold, representing a value of £70,000,000; and careful surveys show beyond question that the reserves of ore still available represent hundreds of millions sterling. The rapid increase in the gold production of the district is shown in Fig. 13.

FIG. 13.



WITWATERSRAND, 1887-1889.

The gold occurs in parallel beds of conglomerate, interstratified with quartzites, sandstones, and schists. Some of the schists are of sedimentary origin, but many, as Dr. F. H. Hatch has shown, are derived from diabases and diorites. The beds, which occur in an oval basin near the surface, assume a high angle, but when followed in depth, show a tendency to flatten. The widths are very variable, the main bed for example varying from 16 feet to a mere thin sheet. By means of boreholes, the beds have been proved to a depth of over 2,500 feet, and deeper boreholes are in progress. The persistency of the beds has led to the starting of many deep-level mines, the prospects of which I discussed in a previous paper.* At the present time there are in the Witwatersrand the outcrop mines, the first and second deep levels, and work has been begun on a third row of shafts that are to reach the auriferous bed at a depth varying from 4,000 to 5,000 feet. These are the "deep deep" level mines from which much is expected. Moreover, it has been proposed by Mr. John Yates to work the still lower depths from these 5,000-foot shafts by starting from the bottom and putting down inclines until the bed is again reached. The depth that he sets as a limit is 12,000 feet, and he would break the inclines into two or three to make winding possible.

The production of some of the larger mines in the Witwatersrand, in 1898, was as follow:—

Mine.	Production of ore.	Yield of gold.
Outcrop Mines:—	Tons.	£
Robinson	182,000	736,000
Simmer and Jack	500,000	672,000
Ferreira	131,000	543,000
Crown Reef	195,000	498,000
Geldenhuis Estate	208,000	475,000
City and Suburban	210,000	474,000
Primrose	256,000	417,000
Henry Nourse	106,000	331,000
Bonanza	63,000	330,000
Glencairn	193,000	286,000
Wemmer	81,000	249,000
Heriot	104,000	236,000
May	108,000	215,000
Worcester	57,000	117,000
Jubilee	63,000	111,000
Salisbury	61,000	102,000
Deep-level Mines:—		
Glen Deep	35,000	765,000
Geldenhuis Deep	263,000	562,000
Crown Deep	267,000	548,000
Rose Deep	248,000	538,000
Village Main	132,000	408,000
Jumpers Deep	124,000	276,000
Robinson Deep	77,000	243,000
Nourse Deep	105,000	226,000

The condition of the mining industry previous to the war can best be seen from the official statistics for 1898. The total output of the

* *Journal of the Society of Arts*, vol. xli., 1893, p. 166.

† *Ibid*, vol. xxxii., 1884, p. 608; vol. xxxvi., 1888, p. 433.

* *Journal of the Society of Arts*, vol. xlv., 1896, p. 57.

Witwatersrand during that year of £15,135,909, was obtained by 103 companies, with a nominal capital of £41,655,939. Of these companies 41 were dividend paying, the sum paid being £4,883,689. The amount of ore brought to surface, mostly from depths of 1,000 feet, was 8,327,699 tons. Of this, 7,275,224 tons were sent to the stamp batteries. In order to reduce this material to fine sand, 6,148 stamps were kept at work, one stamp treating over 4½ tons in 24 hours. A stamp usually weighs 1,250 lbs., and the screens have 600 to 700 meshes per square inch. Of the gold produced, £10,078,193 was obtained from the stamp batteries, and £5,057,716 by chemical treatment.

As one of the earliest and the largest producers the Robinson mine takes the first place. Since its start in 1889 with an initial capital of £50,000, the company has distributed in dividends £2,850,936.

There are other districts in the Transvaal in which auriferous conglomerate has been found, whilst in the De Kaap district gold quartz was at one time largely mined. With the exception of the Sheba mine, the production of the mines in this district shows a tendency to decrease.

At the Sheba mine, which has been in operation for 14 years, the mass of ore has a length of 50 yards, whilst its width in the lower levels has not yet been fully ascertained, for while the upper wall of the deposit is distinctly defined by a thick bed of quartzite, the cross-cuts driven on the lower wall after short intervals invariably encounter fresh ore, and this may continue for some distance since Annie's Fortune, where ore was formerly obtained by quarrying, is 40 yards distant. Owing to a long series of unfortunate circumstances the progress of this mine has not been so satisfactory as the character of the deposit would appear to warrant. Owing to want of adequate water-power the stamp battery originally installed was found unsuitable, and a 60-stamp battery was erected on the De Kaap river and connected with the mine by an aërial wire ropeway four miles in length. Damage was, however, done by floods; and stamps, of which there are 120, are now installed at the mine itself. The working of the mine has been simplified by the sinking of a vertical shaft to cut the deposit at a depth of 300 yards.

In the Zoutpansberg district there are some extensive gold quartz veins, which, when the country is in a settled condition, will probably admit of being worked at a considerable profit. Some of these have been proved to a depth of 150 feet, whilst others are quite undeveloped. The veins are mostly gold-bearing throughout, the yield being 10 dwt. to 1 ounce of gold per ton.

In Matabeleland gold veins, that were extensively worked in ancient times, have given very promising results; and the rapidly-increasing production of this district indicates the probability of its becoming a prominent source of supply. The gold quartz veins of this district have been well described by Mr. Wilkinson,* and some remarkable specimens of the ores were shown at the recent Greater Britain Exhibition at Earl's Court. The best-defined veins appear to be the Rose of Sharon and the Shamrock, belonging to the Bulawayo Exploration Company. They are parallel, 300 feet apart, and give a total length of 3½ miles of gold-bearing ground, marked out by the workings of prehistoric miners. They vary from 1 ft. 6 in. to 4 ft. in width, and traverse talcose slate in an east and west direction.

The mining prospects of the country are very satisfactory. Good progress is being made with railway development; and under agreement with the German Government, the Chartered Company has the right to extend the Rhodesia railway system through German territory to the west coast. Regular monthly returns from the mines were started in September, 1898, and the President of the Rhodesia Chamber of Mines announced at Bulawayo on August 25, 1899, that from September, 1898, to the end of June, 1899, there had been treated 100,506 tons of ore, yielding 54,291 ozs. of gold, worth £192,679. The total output came from a very few mines. The Geelong produced 11,370 ozs., the Dunraven and Bonsor 21,377 ozs. between them, and the Selukwe 12,744 ozs. The average return from the stamps is 11·63 dwt., or £2 2s. 5d. per ton, as against 6·51 dwt., or £1 7s. 3d. per ton on the Witwatersrand.

Let us now turn to the west of Africa. In the Gold Coast Colony gold mining is likely to prove a profitable industry. For centuries the Guinea coast produced enormous quantities of gold, and in its most flourishing days the town of Elmina exported £3,000,000 annually. Early in the 19th century the gold exports of the colony were gradually reduced until an annual average of £120,000 was reached, which is about the present output. The tropical climate and difficulties of transport have hindered the development of the mines. Most of the gold occurs in alluvial deposits. For working deposits of this type the goldfields of Eastern

* *Journal of the Society of Arts*, vol. xlvii, 1899, p. 209.

Akim have recently introduced the hydraulic system of mining. Beds of auriferous conglomerate, similar to those of the Witwatersrand, are being energetically worked by the Wassau Gold Mining Company and several other companies; whilst in Ashanti gold quartz veins are being mined by the Ashanti Goldfields Corporation and by the Obbuassi Syndicate with satisfactory results. Altogether the Gold Coast appears to offer a promising field for European energy and engineering skill; and the view has been unhesitatingly expressed by Mr. J. Irvine* that the mining industry of the colony is likely to meet with unparalleled success in the immediate future.

Australasia.

Of the gold-producing countries of the world, Australasia now takes the second place.

The value of the gold raised in the several Australasian colonies during 1898 and in the period from the first discovery in 1851 to the end of 1898, was as follows:—

	1898.	1851-98.
	£.	£.
Western Australia ..	3,990,698	10,232,655
Victoria	3,349,028	250,738,820
Queensland..........	2,750,349	44,499,955
New South Wales ..	1,244,330	45,732,701
New Zealand	1,080,691	54,453,325
Tasmania	269,813	3,389,106
South Australia......	105,000	1,955,851
Totals......	12,789,909	411,002,413

In Australasia gold is found in veins, in beds, and in masses, the first of these modes of occurrence being by far the most important. Of the veins met with, Schmeisser distinguishes two kinds: (*a*) simple quartz veins, in which the fissures are in the main filled with quartz, and (*b*) composite veins, which the Australian miner designates as "lode formations," in which the fissures have been filled with enclosing rock, greatly altered and intersected by numerous bunches and threads of quartz. The Great Boulder, Lake View, Ivanhoe, and Hannan's Brownhill mines are working veins of this type. An interesting feature of these veins is the occurrence of telluride of gold. The formation of the composite veins appears, Schmeisser thinks, to have been due to the faulting of the strata. During this process great pressure was exerted on portions of the surrounding rock, and the shattered rock lying between the walls of the fissure became partly metamorphosed by mineral solutions, and formed the vein matter. On the other hand Baron Sloet van Oldruitenburgh, Mr. E. Halse, Mr. E. F. Pittman and Mr. W. Frecheville uphold the theory that the telluride-bearing lode formations of the Kalgoorlie district are eruptive dykes, which were rendered permeable to mineral solutions in consequence of contraction fissures of cleavage due to pressure and of shattering.

Of contact veins, which are less frequently met with, striking examples are afforded at the properties of the Wentworth Goldfields Proprietary Company, and of the Aladdin's Lamp Gold Mining Company, at Lucknow, Bathurst county, New South Wales, where the vein occurs between pyroxene-andesite and serpentine.

Of the Australasian colonies, Western Australia has now reached the first place in the production of gold. The extraordinary strides made from 1886 to the end of 1898 were shown in a striking manner by a trophy erected by the Golden Horseshoe Mining Company at the recent Greater Britain Exhibition at Earl's Court. The total output for each year was depicted by a gilt block representing the value of the gold extracted. An examination of the trophy showed that the production which in 1886 was only 302 ounces, amounted in 1898 to no less than 1,050,183 ounces.

The greater portion of the gold of Western Australia is obtained from the Coolgardie goldfields, which were discovered in 1892. The geological structure of the district is simple. On the west there is a mass of intrusive granite succeeded by a belt of schists, the whole being intersected by dykes of eruptive rocks. Recent superficial deposits cover a large portion of the area, and vary in thickness from a few inches to several hundred feet. Gold occurs in alluvial deposits, in lode formations, and in quartz veins. The gold from the recent superficial deposits is of the usual character, much of it being obtained by dry-blowing. The lode formations, as they are called, consist of schistose rocks traversed by a network of quartz veins without sharply defined boundaries. The quartz veins proper are practically confined to the schists. They generally run in a north and south direction, and dip 70° to the east. The development of the Coolgardie region is much retarded by the deficient water supply. The average rainfall is only 7·01 inches; and

* *Journal of the Society of Arts*, vol. xlvii., 1899, p. 305.

artesian wells, though repeatedly tried, have not proved successful. The district in which gold occurs is divided into the following goldfields :—

Name.	Area.	Chief town.
	Sq. miles.	
Coolgardie	11,800	Coolgardie.
East Coolgardie	21,505	Kalgoorlie.
North Coolgardie	37,200	Menzies.
North-East Coolgardie	22,960	Kanowna.

It is remarkable that the most productive mines at the present time are contained within an area $1\frac{1}{2}$ miles long and 1 mile wide. The greatest depths have been attained in the East Coolgardie field, where the Great Boulder Proprietary Mine has reached 900 feet, and the Lake View Consols and other leading mines, 500 feet. The gold output of the principal mines in the East Coolgardie goldfield in 1898 was as follows :—

Name.	Ore treated.	Gold obtained.
	Tons.	Ounces.
Lake View Consols	67,356	98,110
Great Boulder Proprietory	41,043	84,402
Hannan's Brownhill	24,032	50,894
Ivanhoe	27,120	50,660
Associated	27,704	41,908
Golden Horseshoe	10,779	33,972
Great Boulder Perseverance	15,177	18,279
North Boulder	10,150	9,826
Hannan's Oroya	15,412	6,453

Large returns were also made in 1898 by the following mines in other districts of Western Australia :—

Name.	Ore treated.	Gold obtained.
	Tons.	Ounces.
Australian United (Mt. Malcolm)	2,605	5,577
Bayley's United (Coolgardie)	3,961	14,429
Britannia (Niagara)	5,069	4,515
Burbank's Birthday Gift (Coolgardie)	11,414	16,970
Champion Extended (Murchison)	9,951	5,848
Consolidated Murchison (Murchison)	7,000	6,027
Cuddingwarra (Murchison)	3,351	2,241
Cue Consolidated (Murchison)	6,652	4,550
East Murchison United (Murchison)	12,431	13,641
Golconda (Murchison)	1,783	3,990
Lady Shenton (Menzies)	7,328	23,065
Londonderry (Coolgardie)	3,563	4,094
Menzies Alpha Leases (Menzies)	263	1,685
Menzies Consolidated (Menzies)	6,969	6,292
Menzies Crusoe (Menzies)	2,287	4,351
Menzies Gold Reefs (Menzies)	501	4,111
Menzies Mining and Exploration (Menzies)	1,320	1,583
Mount Malcolm (Mt. Malcolm)	6,863	6,713
Norseman (Dundas)	9,584	10,148
Paddington Consols (Broad Arrow)	15,990	8,160
Peak Hill Goldfields (Peak Hill)	3,978	14,017
Premier (Kumanalling)	9,085	5,863
Queen Margaret (Bulong)	6,969	8,839
Queensland Menzies (Menzies)	2,429	8,249
Sons of Gwalia (Mt. Malcolm)	14,495	15,816
Star of the East (Murchison)	8,492	9,012
Wealth of Nations (Kunanalling)	7,715	4,545
Westralia (Coolgardie)	22,615	13,813
White Feather Main Reef (Kanowna)	10,212	9,822

In the statistics of gold production for 1898 Victoria follows Western Australia, and although Victoria is the smallest State in Australia, its total yield of gold and the stability of its gold resources entitle it to the first place. Since the early discoveries in 1851, no less a sum than £250,738,824 has been obtained from a comparatively small portion of the proved gold-bearing area. New discoveries in its forest-clad mountains are constantly being made, and alluvial deposits concealed beneath basaltic flows are being traced by boring operations. In Victoria, too, mining is prosecuted in so economical a manner that useful lessons may be learned, showing that rich ore is not indispensable to the profitable working of a gold mine. Gold-mining is being carried on at great depths. At the present time there are in Victoria seven mines over 3,000 feet in depth. The results of deep mining have been eminently satisfactory. Thus, the New Chum Company in 1894 discovered a payable gold quartz vein at a depth of 2,878 feet, from which 40,778 tons of ore were raised in 1895 to 1898 yielding 35,551 ounces of gold or $17\frac{1}{2}$ dwt. to the ton, and enabling dividends amounting to £78,391 to be paid. The company is now working the vein with profit at a depth of 3,000 feet. As regards economy in management the Victorian mines are unequalled. This is well shown by the results obtained by the Stewart's United Company, at Bendigo, which was able to pay a dividend on a yield of 2 dwt.

to the ton. As further illustrations I might cite particulars of seven of the most successful mines. The total output of these mines in 1898 was 373,320 ounces. The expenses of management amounted to only £2,159; whilst the dividends paid were £223,462, or 60 per cent. of the gold obtained, and 131 per cent. of the paid-up capital of £170,440. Expenses of management (directors' and auditors' fees and manager's salaries) amounted to only 0·58 per cent. of the gold raised or 1½d. in the pound.

Victoria possesses seven goldfields: Bendigo, Castlemaine, Maryborough, Ballarat, Ararat, Beechworth, and Gippsland. Some of the deposits present many points of interest. The class of bedded veins, known as "saddle reefs," occurring in the Bendigo field, have already been described. In Gippsland there are other interesting veins known as "flat veins," that occur in dykes of diorite. The production of the various districts in 1898 was as follows:—

	Ozs.
Bendigo	214,205
Ballarat	186,696
Beechworth	111,703
Gippsland	106,793
Castlemaine	71,778
Maryborough	54,339
Ararat	38,906

In Queensland gold is now the most promising and most important industry. The yield of gold in Queensland was shown in a picturesque manner at the recent Greater Britain Exhibition by a reproduction of Temple Bar. The edifice was 30 ft. wide and represented 837·07 cubic feet of gold or 395 tons 13 cwt., the total output of Queensland from the first discoveries in 1858 to the end of 1898. The value of the gold is £45,236,212. There were also obelisks representing the gold output of the following goldfields:—

Goldfields.	Dates.	Output.	Value.
		ozs.	£
Charters Towers	1872-98	4,399,725	15,179,051
Mount Morgan ..	1858-98	2,222,045	8,888,180
Gympie	1867-98	2,311,900	8,091,650
Palmer	1873-98	1,356,370	5,425,480
Croydon	1885-98	761,064	1,921,687
Ravenswood	1868-98	497,725	1,742,037
Etheridge	1880-98	601,034	1,682,895
Hodgkinson	1876-98	242,073	847,255
Clermont	1860-98	210,845	716,873
Gladstone	1862-98	123,919	433,716
Eidsvold	1886-98	104,709	379,570
Coen River	1876-98	30,031	86,339

The most remarkable deposit in Queensland is that of Mount Morgan. In 1898 the property yielded 168,786 ounces of gold valued at £680,202, making a total since its discovery of £8,563,182 worth, and for many years past the annual output has been increasing. Between September, 1886, and the present time it has paid £5,000,000 in dividends or £5 per share. It affords employment to 1,611 men, and supports a town of 5,000 inhabitants. It is curious to note that the ground on which the mine is situated was sold, after the discovery of traces of gold, for £1 an acre. Geologically the deposit presents many points of difficulty. Worked as an open quarry, it consists of a mass of brown iron ore passing into a ferruginous siliceous sinter in a frothy and cavernous condition. Both the iron ore and the sinter are rich in gold in a state of remarkable purity. Mr. R. L. Jack, who was the first to investigate the deposit, considers that it is the product of a geyser. It is doubtful, however, whether his view is correct, as later developments have shown the pyritic nature of the lower levels, and this suggests that the curious character of the deposit is the result of the surface alteration of a vein highly charged with pyrites.

The Mount Morgan mine possesses the largest chlorination plant in the world. Practically the whole of the large output of gold from the mine (2,000,000 ounces) has been extracted by chlorination. Recent developments show that the size of the ore body is well maintained in the lower levels, and that the ore at the 600-foot level is as rich as any found above. A main shaft is being sunk to 1,500 ft. below the original top of the ore deposit, and there is no doubt that Mount Morgan will produce large quantities of gold for many years to come.

In New South Wales, gold is mined in many localities, the most prominent being the New England, Clarence, Peel, and Hunter districts in the north, the Mudge, Tambaroora, Bathurst, Lachlan, Cobar, and Albert districts in the west, and the Tamul and Adelong districts in the south. At the Wentworth goldfield there is an interesting instance of a gold vein associated with diorite. The vein occurs at the junction of serpentine with a felspathic rock, which in places passes into diorite. As a rule, the New South Wales veins are smaller and richer than those in Victoria, and occur mostly in rocks of Upper Silurian or Devonian age. There is a remark-

able illustration of the occurrence of gold in beds at Belubula, near Carcoar. Interstratified in slates, the auriferous beds are of a sandy nature. They vary in their gold contents from traces to 1 ounce per ton, and exhibit a well-marked stratification.

While gold mining was making rapid progress in Australia, in New Zealand it remained until the last year or two nearly stationary. Possibly this is due to the fact that investors, attracted by the phenomenal yields of the Western Australian gold veins and by the regularity of the Transvaal auriferous conglomerate beds, held aloof from a country where the veins give less sensational returns. Nevertheless, New Zealand possesses numerous gold veins, some of which are of great width and richness. It has, too, an abundant supply of labour, of fuel, of timber, of water, and of hydraulic power, all valuable factors for economical mining. The auriferous districts are three in number, (1) Hauraki, on the North Island, comprising the Coromandel peninsula; (2) the west coast of South Island, with the Reefton and Lyell veins and numerous deposits of auriferous gravels; and (3) Otago, in South Island. Most of the veins are of the bedded type and occur chiefly in rocks of Eocene age. Among the richest veins are those worked on a large scale at the famous Waihi mine, where exceptional results have been obtained with the cyanide process, the production in 1898 being £242,871. In the Lower Thames district some of the early discoveries were highly sensational. Within an area of 640 acres over £6,000,000 of gold was won from workings of slight depth. The Caledonian mine alone yielded in two weeks 25,000 ounces of gold. The Hauraki mine, Coromandel, which has reached a depth of 1,000 feet, is a striking proof of the persistency of the New Zealand veins. Since 1895, the date of the formation of the company, 11,057 tons of ore has been crushed yielding 75,794 ounces of gold. Placer mining is profitably carried on in the Otago district. At Humphrey's Gully belonging to the Consolidated Goldfields of New Zealand and in other cases the alluvial deposits are worked in a systematic manner by hydraulic mining. The Otago district, too, is the home of the gold-dredging industry.

Tasmania has three gold districts, the North Coast, the North-eastern district, and the West Coast. The last includes the famous deposits of Mount Lyell, which, although worked chiefly for copper, yield as a by-product large quantities of gold. Some 2,000 ounces of gold per month is shipped in the form of crude copper.

From this summary of the gold resources of Australasia we see that gold mining is being carried on with great vigour and success; and there is no doubt that for many years to come the Australian goldfields will continue to contribute important quantities of gold to the world's supply. Provided that the general conditions are favourable, it is possible to work to a depth of 3,600 to 4,500 feet. In proof of this may be cited the conditions in Victoria, where there are several mines over 3,000 feet in depth, and in the Charters Towers goldfield of Queensland, where the Day Dawn Mine has been found rich in gold down to 2,200 feet. From the thickness, length, and regularity which characterise many of the veins in the Australasian goldfields, it may be assumed that they are likely to extend to great depths. In the course of time other payable deposits will probably be found in addition to those at present being worked. In Australia the extreme barrenness of the land has prevented the discovery of many deposits, while in Tasmania and New Zealand the excessive luxuriance of the vegetation still conceals many treasures.

United States.

In the United States in 1837 gold mining was confined to the Southern States, where an insignificant yield was obtained from alluvial deposits. Since the discovery of gold in California on the American River at Sutter's Dam in 1848, the gold mining industry of the United States has developed in a remarkable manner, notwithstanding the oscillations in production caused by the exhaustion of alluvial deposits and the discovery of others. The tributaries of the Sacramento yielded £8,000,000, but with the exhaustion of these rich placers the yield of California fell off after 1851. Later on the *débris* legislation of California again reduced the annual production by restricting the working of old river beds by hydraulicking. A Bill has, however, recently been passed permitting the adoption of hydraulic mining, provided the *débris* is impounded; and this method of mining is again coming into prominence. The gold veins, in the mining of which mechanical appliances of the best design have been unstintedly used, have, however, proved a permanent source of supply. Conspicuous amongst these is the great Mother Lode of California, a vein, or mineralised zone, extending for 100

miles, with a thickness varying from 6 to 60 feet. The number of gold deposits now being worked in the United States is so great that it is impossible for me in the time available even to enumerate them. I can merely mention a few of the more remarkable ones. In the State of Nevada the most remarkable is undoubtedly the Comstock Lode, an auriferous quartz vein 20 to 60 feet thick, extending for a distance of 22,546 feet, and occupying the line of contact between diorite and diabase. The deposit was first mined in 1859, and by 1880 the total length of shafts and galleries had exceeded 150 miles. In 30 years the vein yielded £25,000,000 of gold and £39,000,000 of silver. It is, however, no longer worked on a large scale. A curious phenomenon is the intense heat that prevails in the lower levels at a depth of 3,000 feet. This has generally been ascribed to expiring volcanic action. Many notable improvements in mining methods were introduced at the Comstock mines. For excavations of great width, the system of timbering in square sets was first used. Here, too, the first electric plant was installed under ground. By far the greater portion of the gold now mined in the United States is obtained from Colorado. In that State the gold veins of Cripple Creek occur in association with dykes of igneous rock traversing granite and gneiss, the gold being usually accompanied by tellurides. The most remarkable example of the occurrence of gold in masses is afforded by the Treadwell mine on Douglas Island, Alaska, where the deposit consists of a mass of auriferous altered granite. Although the yield is under half an ounce of gold to the ton, the amount of ore available is so great and the cost of quarrying it so low that exceptionally good returns have been obtained. On Douglas Island there are now 880 stamps with a capacity of 2,500 tons of ore daily.

Russia.

The Russian Empire, which in the decade previous to the discovery of gold in California and Australia, produced 40 per cent. of the world's supply, still yields large quantities of gold, the actual amount showing an annual increase, although the proportion of the Russian production shows a decrease. Most of the gold is obtained from alluvial deposits in Siberia. Quartz veins, though little mined, are not unknown. A peculiar characteristic of the Siberian placers is that the soil is perpetually frozen, or can be thawed only with great difficulty in the summer. The gold-bearing districts are now being penetrated by railways, and placed in communication by sea with Europe. The Russian Government, by the decree of June 11, 1899, admitted mining machinery and potassium cyanide free of duty, and is facilitating in other ways the development of mines, and encouraging the introduction of foreign capital. It is probable, therefore, that the primitive methods of mining employed will be improved, and the output increased, with the result that Russia will become a more important source of supply.

Canada.

In Canada substantial progress is being made in gold mining. The introduction of important processes for the metallurgical treatment of the ore, and of better methods of mining, together with the growing interest in the development of the mineral resources of the Dominion, indicate that this progress is likely to be maintained for many years to come. According to the "Canadian Mining Manual," the gold production in 1898 was as follows:—

	£
North-West Territories	1,614,000
British Columbia	569,000
Nova Scotia	120,000
Ontario	55,000
Quebec	1,300
	2,359,300

This estimate is slightly lower than that of the Director of the United States Mint.

The first place in the production of gold is taken by the North-West Territories, in which are included the remarkable alluvial deposits of the Klondike, which have been vigorously worked during the past two or three years in spite of the almost insuperable obstacles that the miner has to face—the intense cold of the arctic climate, the continuous night of the long winter, the swarms of mosquitos, and the fever and scurvy, which after a season or two invariably attack the unfortunate adventurer who is deprived of fresh meat and vegetables. Moreover, for one who discovers a payable claim, there are hundreds who toil for years making only a bare subsistence.

The Klondike goldfield is situated in the Yukon district, in the North-West Territory of Canada. The deposits were recently described in a paper read before the Society by Mr. W. H. Merritt.* The hardships of the pioneer miners were very great. To reach the gold-

* *Journal of the Society of Arts*, vol. xlvi., 1898, p. 655.

field a long and arduous journey has to be made. Since 1896 some 40,000 people have passed along the difficult routes, in most cases with an equipment weighing 400 lbs. Happily, a railway, a triumph of engineering skill, is in course of construction over the White Pass, and the terrible sufferings of the pioneers will be a thing of the past. The railway is now open from Skagway to the head waters of inland navigation at Bennet lake, a distance of 41 miles; and a telegraph line to Dawson City, of which the construction was entered upon in March, was completed in October, 1899. It was the fur trade that led the early explorers to push onward through the Hudson Bay region and Alaska, and the Yukon gold discoveries have been made only after twenty years persistent exploration.

The Klondike goldfield covers about 1,000 square miles. The original rugged mountains have been planed into gentle slopes by glacial erosion, converting the country into a series of swelling hills and deep valleys, from 3,000 to 4,000 feet above sea level. The rocks underlying the gold-bearing regions are, according to Mr. J. B. Tyrell, mica-schists and quartzites of Palæozoic age, cut by quartz veins and dykes of eruptive rocks. Few traces of gold are found in the schists, the gold being concentrated in the recent sands of rivers, and in the gravels of ancient moraines. On Bonanza and El Dorado creeks there are rich claims in a glacial moraine, the gold occurring at the bottom of a bed of coarse sand, apparently formed by glacial action. The gold in large nuggets, with much quartz, is little water-worn. While the gravels in the valleys vary from 6 to 20 feet in thickness, gravel and clay on the hill sides may be 50 feet thick. It would thus appear that the gold came from the quartz veins and accompanying rocks, the medium of distribution being the glaciers. The rapid concentration locally of the gold may have been due to glaciers not carrying the detritus far, there being none of the scattering force of great rivers.

The early Spanish, Russian, and British explorers of the Alaskan coast did not discover gold, nor do the natives, who had no word for gold, appear to have had any knowledge of its existence. This is the more remarkable, as they exhibited a considerable degree of civilisation. It may incidentally be mentioned that the natives in the vicinity of the goldfields form a fruitful source of investigation for the student of anthropology.

In Canada, next in importance to the alluvial gold deposits are the gold ores of the Rossland district, West Kootenay, British Columbia. The gold occurs in well-defined veins of cupriferous magnetic pyrites, a mineral very similar to the nickel ore of Sudbury, Ontario. Mining began in the district in 1889, and the industry has now attained large proportions. The veins, which traverse eruptive rock, in places assume great width, in one case as much as 66 feet. Returns from the smelting works show that in the years 1894-99 there were treated 128,428 tons of Rossland ore, which yielded 18,519 ozs. of gold, 251,412 ozs. of silver, and 4,346,870 lbs. of copper. The most productive mine is the Le Roi, a mine that has paid £165,000 in dividends, and has large reserves of good ore available. It has now reached a depth of 900 feet. In 1898 this mine raised 66,000 tons of ore, yielding 1,056,000 ozs. of gold and large quantities of silver and copper. The War Eagle, another mine in the same district, is 800 feet deep, the vein being 10 feet wide. The mine, which is equipped with an electric winding plant and with compressed air rock-drills, in 1898 raised 42,779 tons of ore, yielding 808,523 ozs. of gold. The Velvet, a mine situated ten miles from Rossland, is 250 feet deep. The vein is 10 to 20 feet in width and contains 2 to 15 per cent. of copper and over an ounce of gold to the ton. In the Nelson district of West Kootenay among the promising mines that are now being vigorously developed are the Ymir gold mines, with a vein 30 feet in width opened to a depth of 450 feet, the Granite mines with rich free-milling ores, and other mines of the Duncan group. In the Slocan district of West Kootenay the Queen Bess mines yield principally silver ores.

Mexico.

Although Mexico is best known from the fact that it ranks first in the world's production of silver, the production of gold in the republic is by no means inconsiderable. The rich silver veins usually contain gold, and in the district of Tatatila and Zomelahuacan gold quartz veins are worked. In several cases gold mining is carried on in a very profitable manner. The Grand Central Mining Company, for example, a company formed three years ago with a capital of £250,000, for working gold deposits in the State of Sonora, has earned a profit of £300,000.

India.

In ancient times India produced enormous quantities of gold. The Hindu sacred books

refer to the use of bags of gold dust as currency, and history and legend point to the existence of sources of gold supply now unknown. At the present time gold mining is chiefly confined to the Wynaad and the Colar district of Mysore. Work has also been done in Hyderabad and in the Chota-Nagpore district in Bengal. The gold occurs in quartz veins traversing schistose rocks and the underlying gneiss. In 1899 the gold production of India amounted to 446,323 ounces. The following are the particulars of the results obtained in 1898 by the principal companies at work in the Colar field of Mysore :—

	Tons crushed.	Value of gold.
		£
Mysore	595,743	3,413,395
Nundydroog	273,321	1,216,703
Ooregum	399,759	1,974,189
Champion Reef	366,868	1,954,726
Mysore West	52,838	100,429
Mysore Reefs	15,355	28,029
Nine Reefs	23,594	24,858
Coromandel	42,110	103,951

The value of the gold produced by the Mysore, Ooregum, and Nundydroog mines has shown a steady increase year by year. The progressive opening up of the goldfields in the face of many difficulties and disappointments is an important testimony to the permanence of India as a source of gold supply.

Other Countries.

Of the occurrence of gold in China little is known. Veins of gold quartz have been worked under European management from time to time in Shantung. Gold is mined extensively by the Chinese, and Korea and the island of Formosa are known to be rich in the precious metal. Mr. R. P. Rothwell estimates that the production of gold in China in 1898 amounted to £1,328,000, and that in Korea to £219,000. The production in Japan he puts at £143,000, that in Further India at £103,000, and that in Borneo at £20,000. It is not improbable that in the near future the Phillipine Islands will take an important place in the world's gold production.

The Republic of Colombia, the northernmost State of South America, has long been famous as a gold-producing country, and offers a promising field for future development. Among the richest and most extensive mines are those of the Frontino and Bolivia Company, in Antioquia, where veins of gold quartz in granite occasionally assume a phenomenal value. Since 1888 this company has uninterruptedly paid dividends of 15 to 40 per cent. The mines of the Tolima Company, in the department of that name, are also very important, and large quantities of alluvial gold are produced by the Colombian Hydraulic Company and by the Gravel Gold Mines of Colombia. From a historical point of view, the most interesting is that worked by the Darien Gold Mining Company. Ancient Spanish records tell of the fabulous riches of the Espiritu Santo vein, and bring the history of the mine down to the year 1727, when the workings were abandoned, owing to attacks by hostile Indians. Firmly believing in the accuracy of the old records, Mr. Hammersley Heenan, of Manchester, was instrumental in forming, in 1888, an Anglo-French company with a capital of £200,000. The management refused, however, to believe in the records, and started working new mines with little success. Mr. E. R. Woakes was then appointed manager of the apparently played-out concern, and turned his attention to a mine, the surface workings of which struck him as resembling a long deserted quarry, covered with dense forest. This proved to be the celebrated Espiritu Santo mine, and after unsuccessful attempts to pump out the water, the funds of the Darien Company were exhausted. Mr. Woakes then undertook to drive an adit level 1,100 feet in length to tap the old workings if £5,000 could be raised. This was soon done, and the adit was started in August, 1893. It was completed in a year and the water flowed away into the river, opening up the long lost wealth of the mine. The old workings 200 feet below the surface were very remarkable. Five tread-wheels were found in good preservation which had been used for raising the water in 30-foot lifts. Leather buckets, ladders of primitive construction and iron bars were also found. The timbering was in perfect preservation although it had been submerged for nearly 200 years. Shafts have now been sunk and machinery of the latest design installed, the development being paid for by the gold produced. It is probable that the mine has now a brilliant future before it. The deposit is a mineralisation of the surrounding rock, andesite, on all sides of several parallel fissures, with free gold occurring in quantity in occasional pockets and veins. The pertinacity of the Spaniards in carrying out deep mining operations in the heart of a hostile

tropical country, without machinery, explosives or outside resources, was indeed an achievement, whilst the skill of the manager, Mr. Woakes, in opening up the mine, and the loyalty of the shareholders in supporting the mine through good and evil report are alike deserving of admiration. The value of the gold produced in Colombia in 1898 was £740,000.

There is no doubt that the ancient reputation of Brazil as a gold-producing State is likely to be maintained. The gold industry of Minas Geraes was in so flourishing a condition from 1700 to 1800 that the State was regarded as one of the richest in the world. Under the colonial system of Portugal, which was one of selfish exclusion and greedy extortion, the industry was burdened by restrictions and monopolies, and all development was checked. At the time of the revolution in 1840 the industry was at its last gasp, and since then very slow progress has been made. Now, however, that the Government is firmly established, rapid advances may be expected. In the States of Minas and Goyaz, gold mining operations are being vigorously carried on. The gold is usually disseminated in beds of rocks, known as itacolumite, itabarite, and jacotinga. Among the well-known mines now in operation I may mention that of the St. John del Rey Mining Company, formed in 1830, to work the celebrated Morro Velho mine in Minas Geraes. This company, in the six months up to August 31, 1898, crushed 45,761 tons of ore, which yielded £137,574 worth of gold. The Ouro Preto Gold Mines of Brazil, another prosperous company working gold deposits in Minas Geraes, during the year ending June 30, 1899, raised 69,400 tons of ore, which yielded 19,977 ounces of gold.

The vast territory of Guiana, consisting of the five divisions known respectively as Venezuelan, British, Dutch, French, and Brazilian Guiana, abounds in gold, both in alluvial beds and in veins; and there is no doubt that, were it not for political complications and the unhealthiness of the climate, the region might be developed so as to play an important part in the world's gold supply. Indeed the El Callao mine of Venezuelan Guiana has ranked among the most productive gold quartz mines of the world. Guiana is a region of great historical interest. From the time of its discovery, 400 years ago, the imagination of the Spanish settlers was fired by the account given by the Indians of the abundance of gold in the interior. Many expeditions were fitted out to seek for the gold deposits. Amongst others, Sir Walter Raleigh started, in 1595, in search of "Manoa, the imperial city of Guiana, which the Spaniards call El Dorado." On his return he published an account of his adventures, a fascinating volume, bearing a close resemblance to the mine prospectuses of modern times. The existence of gold in Guiana has since invariably been regarded with incredulity, and one frequently comes across allusions to the "El Dorado myth." The rapid increase of the gold production of British Guiana alone, from 250 ounces in 1884 to 121,490 ounces in 1898 proves, however, the accuracy of Sir Walter Raleigh's belief in the gold resources of the region. The recent award in the Venezuelan Arbitration has placed almost the whole of the extensive goldfields of the region in dispute definitely under British control. It may, therefore, reasonably be anticipated that the auriferous area will be more fully investigated, and that the progressive returns recently shown will long continue. The value of the gold produced in British, Dutch, and French Guiana in 1898 was £163,000.

Mr. Rothwell estimated that the production of gold in the other South-American States, in 1898, was as follows:—Argentine Republic, £63,000; Bolivia, £66,000; Chili, £281,000; Ecuador, £26,000; Peru, £41,000; Uruguay, £8,000; Venezuela, £163,000. The production of gold, in 1898, in Central America was £105,000.

Excluding Russia, only insignificant quantities of gold are produced in Europe, in Austria, France, Germany, Italy, Norway, Spain, and Sweden. In Hungary, where the production in 1898 was £408,000, the gold mines are of greater importance. The gold veins of Transylvania are of special interest, in that they occur in eruptive rocks, the gold being associated with tellurides, whilst the gold mines of Schemnitz, which I have described in a previous paper,* occupy with regard to age, extent, and production, a place among the most celebrated mines of the world. Historically these mines are of interest as the scene of the first use of gunpowder for blasting, in the year 1627.

SILVER.

Prior to the Christian era Spain and Greece yielded large quantities of silver. In Greece the richest mines were those of Laurium, which produced some 2,100,000 tons of lead

* *Journal of the Society of Arts*, vol. xxxvi., 1886, p. 266.

and 18,000,000 lbs. of silver. These mines are still extensively worked, and the old slags and mine waste have proved a fruitful source of supply of metal. During the eight centuries preceding the discovery of America, Spain and Germany yielded the greater portion of the silver supply. Mexico and Peru, and, at a later date, Chili and Bolivia became great silver-producing countries, whence a steady supply still comes. With the discovery of the Comstock Lode in Nevada in 1859, and the subsequent rich discoveries in Colorado, Utah, and Arizona, the United States rapidly rose to a pre-eminent position in the production of silver, and long held the first place, closely followed, however, by Mexico; these two countries together furnishing considerably more than half the world's supply.

According to the estimate of the Director of the United States Mint the world's production of silver in 1898 amounted to 165,296,000 troy ounces. Mexico took the first place with 56,738,000 ounces, or 34·4 per cent. of the total production. The United States came next with 54,438,000 ounces, or 33 per cent. Then followed Australasia with 12,022,000 ounces, or 7·3 per cent. The remaining 25 per cent. was produced by Bolivia, Peru, Germany, Spain, Chili, Canada, France, Japan, Colombia, Central America, Italy, and Austria, with trifling additions from other countries.

The British mines in 1898 yielded £33,634 worth of silver, all of which was obtained from the argentiferous galena of the lead mines. Of true silver workings there have been several examples in the past in Cornwall, but they have lasted only for a short time, being generally limited to the junctions of cross-veins with others.

Silver ores are obtained almost entirely from veins or from masses. The exceptional instances in which they are met with in beds are at Mansfeld in Germany, where silver occurs in the copper ore disseminated through shale, and in Utah, where beds of Triassic sandstone impregnated with chloride of silver are largely worked.

The veins vary considerably in character, in their relation to the enclosing rock, and in the nature of the ores. Roughly, however, they may be divided into veins of true silver ore, those of argentiferous lead ore, and those of argentiferous copper ore. Typical examples of the occurrence of silver ore in veins are afforded by the following localities: Freiberg, in Saxony; St. Andreasberg, in the Hartz; Przibram, in Bohemia; Kongsberg, in Norway; Huanchaca and Potosi, in Bolivia; Chanarcillo and Caracoles, in Chili; Guanaxuato and Zacatecas, in Mexico; Silver Islet, in Lake Superior; Kootenay and the Slocan, in British Columbia; Zeehan and Dundas, in Tasmania, and Broken Hill, in New South Wales.

The Przibram mines are of special interest on account of the great depth attained. The veins, consisting chiefly of argentiferous galena, traverse Lower Silurian rocks. They vary in thickness from one inch to 20 feet, and, as a rule, the width of the vein and the proportion of silver in the galena increase with the depth. The greatest depth yet reached is 3,511 feet at the Maria shaft, and the total length of galleries in the mines exceeds 152 miles. The output in 1898 amounted to 263,979 tons of ore, containing 1,250,000 ounces of silver and 4,826 tons of lead.

The St. Andreasberg veins, which have long been famous for their rich and rare silver minerals, are very thin, seldom exceeding 2 ft. in thickness. They are now nearly exhausted, and there is little hope for their future productiveness.

In many cases the veins contain native silver, notably at the famous mines at Kongsberg in Norway, which have been worked since 1623. In the Copenhagen Museum there is a single piece of native silver from these mines weighing 560 lbs. In 1898 a mass of native silver weighing 660 lbs. was obtained from the Himmelsfürst mine at Freiberg.

Perhaps the most remarkable silver mine in existence is that at Huanchaca, whence the bulk of the Bolivian production is obtained. It was long worked by a native company, which deserves credit for having overcome unusual difficulties. The mine is situated at an altitude of 12,400 feet above the sea, the nearest port being 400 miles distant. From 1877 to 1888 the production of the mine amounted to £10,000,000, and the clear profit to £4,000,000. In 1898 the output of silver was 4,631,334 ounces. This production was, however, exceeded by the Broken Hill Proprietary Company which obtained 5,565,230 ounces.

The masses in which silver ores are met with are very irregular in their occurrence, and in most cases they do not continue to be productive at great depths or for long distances. Many of the enormous silver deposits of the United States, such as those at Leadville * in Colorado, belong to this category.

* See paper by Mr. T. W. Goad, *Journal of the Society of Arts*, vol. xxxvii. 1889, p. 177.

It is possible that other similar deposits exist, and may some day be mined. In Europe there are also some striking examples of this class of deposit. At Laurium, in Greece, for instance, silver ore occurs in irregular masses in limestone and at the contact of limestone and mica schist. Again, at Sala, in Sweden, the ore occurs in irregular masses in dolomite. These mines are of interest on account of their antiquity, and also on account of the fact that they have been worked to a depth of 990 feet without blasting.

Less than half of the world's supply of silver is now produced from silver ores. The remainder is obtained from the metallurgical treatment of other ores, in which silver is a more or less important constituent. Since these ores will continue to be mined for the other metals they contain, a steady supply of silver is assured. In the case of true silver ores, a slight rise in the price of silver will enable many deposits now untouched to be worked. A considerable increase in price cannot, however, be expected for some time to come. Meanwhile the silver miner has to exercise great care in management to pay expenses. The serious fall in the price of silver of late years is shown by the following statement of the average price of standard silver on the London market during the past 14 years:—

Year.		Average price per oz.	Year.		Average price per oz.
1885	....	$48\frac{5}{8}$d.	1892	....	$39\frac{13}{16}$d.
1886	....	$45\frac{3}{8}$d.	1893	....	$35\frac{5}{8}$d.
1887	....	$44\frac{5}{8}$d.	1894	....	29d.
1888	....	$42\frac{7}{8}$d.	1895	....	$29\frac{1}{2}$d.
1889	....	$42\frac{11}{16}$d.	1896	....	$30\frac{3}{4}$d.
1890	....	$47\frac{3}{4}$d.	1897	....	$27\frac{9}{16}$d.
1891	....	$45\frac{1}{16}$d.	1898	....	$26\frac{15}{16}$d.

Miscellaneous.

BRITISH TRADE AND SHIPPING IN 1899.

The total trade of the country last year resulted in the import and export of goods to the value of £814,570,241, against £764,558,690 in 1898. Of this, inports were responsible for £485,035,583, against £470,544,702, and exports for £329,534,658, against £294,013,988, the latter being constituted by British produce and manufactures to the value of £264,492,211, against £233,359,240, and foreign and colonial merchandise worth £65,042,477, against £60,654,748. Of the imports, goods valued at £378,206,288 were brought from foreign countries, as against £370,921,685 in the previous year, and to the value of £106,829,295, as against £99,625,017 from British possessions, including protectorates. Of the exports foreign countries bought our products to the value of £235,285,062, as against £203,903,252 in 1898, while our own possessions were our customers to the sum of £94,249,596, as against £90,110,736.

The total number of vessels entered at British ports in 1899 was 326,143, of a tonnage of 86,814,570, compared with 327,377 vessels of 85,132,533 tons in the previous year. Of these boats 85,669 were driven by steam and 240,474 by sails, as against 91,547 and 235,830 respectively in 1898. Of foreign vessels 10,508 sailing ships and 23,170 steamers entered British ports in 1899, the grand total of entries being 359,821 vessels of 105,188,504 tons. A considerable falling off was manifest in shipbuilding, the total output in the United Kingdom (exclusive of vessels built for the Royal Navy and foreigners) being 1,245 vessels, with a tonnage of 749,414. In 1898 the figures were 1,370 vessels and 695,997 tons.

General Notes.

A YEAR'S COINAGE.—The gold coinage produced at the Royal Mint during the year ended June 30th amounted to £13,904,615, out of which 17,641 sovereigns and 2,195 half-sovereigns, or £18,738 10s., were placed in the pyx for use at the trial. The "silver moneys" coined amounted to £1,806,552, out of which 9,146 coins, comprising nine denominations, were deposited in the pyx. The Perth Mint, Western Australia, sent 1,393 sovereigns, representing £976,639 coined from June 20th, 1899, to March 31st last. The gold and silver coinages from the Royal Mint are, with one exception, each the largest that have taken place during the past twenty-five years. In 1892-3 the gold coinage was exceeded by £900,000, and in 1889-90 the silver by £400,000. The heavy coinage was attributed to money required for the purposes of the war.

MEMORIAL OF KING ALFRED THE GREAT.—The Mansion-house Committee announce that the contract with Mr. Hamo Thornycroft, R.A., for the colossal statue of King Alfred the Great has been entered into, and the work will be completed by Midsummer next. The full-sized model in clay has already been finished. The statue itself measures 14 ft. from the crown to the feet. The figure of the king is represented standing with one arm resting on his shield, the other held aloft, the hand grasping his sword so that the cross hilt is held uppermost. The pedestal, of rough-hewn granite, is a single block, will be over 20 ft. high, and will weigh close on 40 tons. About £4,448 has already been received or promised towards the memorial, and £2,000 more is required. Subscriptions may be sent to the Lord Mayor at the Mansion-house, to the principal banks, or to Mr. Alfred Bowker, the hon. secretary, King Alfred Commemoration Fund, Guildhall, Winchester.

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FRIDAY, AUGUST 3, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS.

In future the Society of Arts Examinations will consist of Three Grades.

I. Preliminary or Junior.

II. General or Intermediate.

III. Senior.

It is not proposed to hold an examination in the Senior Grade in 1901.

Information respecting the Preliminary Grade and full Syllabuses will be found in the *Journal* for June 14 last. Separate copies of the Syllabus can be obtained on application to the Secretary.

The dates for the Examinations in 1901 are provisionally fixed for Monday, Tuesday, Wednesday, and Thursday, March 18th, 19th, 20th, and 21st.

The Programme for 1901 is now in preparation, and will be published as soon as ready.

The results of the Examinations held at the end of last March have been published. Copies of the list can be obtained at the Society's office, price 6d. each.

Proceedings of the Society.

CANTOR LECTURES.

THE NATURE AND YIELD OF METALLIFEROUS DEPOSITS.

By Bennett H. Brough.

Lecture III.—Delivered February 5, 1900.

Iron.

The history of iron mining goes back far beyond the periods of authentic records. The discovery of iron is attributed to Tubal Cain or to Vulcan, and there are numerous references to iron in the poems of Homer. In Europe the rich ores of Spain and Elba were much used during the Roman period. Remains of the Roman working of iron mines have also been found in the Forest of Dean, in the Weald of Sussex, in Belgium, and in Austria. Indeed, the iron left in the slag heaps of the Forest of Dean furnished the chief supply to 20 furnaces for nearly 300 years. The ancient iron masters were unable to work any but the purest ores. The introduction of coal as fuel for smelting by Dud Dudley in 1618, and by Abraham Darby in 1713, the replacement of coal by coke, the invention of James Watt's steam engine in 1770, of puddling by Henry Cort in 1784, of the hot blast by Neilson in 1828, of the Bessemer process of making steel in 1856, of open-hearth steel making in 1861, and of basic steel making in 1879, are a few of the great improvements that have stimulated the iron ore mining industry, and have rendered it possible to work very impure material. Indeed, improvements in the methods of mining and of smelting iron ores have followed in rapid succession, with the result that the world in 1898 produced no less than 35,741,000 tons of pig iron, the result of the smelting of 73,670,000 tons of iron ore.

The development of the iron industry during the past half century has been remarkable. In 1854, Mr. J. K. Blackwell* read in this room, a paper in which he gave the following as the world's production of pig iron:—

	Tons.	Per cent.
United Kingdom	3,000,000	50·0
France	750,000	12·5
United States	750,000	12·5
Germany	400,000	6·6
Austria	250,000	4·3
Belgium	200,000	3·3
Russia	200,000	3·3
Sweden	150,000	2·5
Other countries	300,000	5·0
Total	6,000,000	100·0

In 1898 the world's production of pig iron was as follows:—

	Tons.	Per cent.
United States	11,774,000	32·7
United Kingdom	8,610,000	24·1
Germany and Luxemburg	7,402,000	20·6
France	2,534,000	7·1
Russia	2,194,000	6·2
Belgium	979,000	2·8

* *Journal of the Society of Arts*, vol. iii.

	Tons.	Per cent.
Austria	958,000	2·7
Sweden	532,000	1·5
Hungary	384,000	1·3
Spain	262,000	0·7
Canada	69,000	0·2
Japan	16,000	} 0·1
Bosnia	15,000	
Italy	12,000	
Total	35,741,000	100·0

The relative position of the mining industries of the various countries is better shown by the following statement of the world's output of iron ore in 1898:—

	Tons.	Per cent.
United States	19,278,000	26·2
Germany and Luxemburg	15,893,000	21·6
United Kingdom	14,177,000	19·3
Spain	7,126,000	9·7
France	4,582,000	6·2
Russia	4,108,000	5·6
Austria-Hungary	3,335,000	4·5
Sweden	2,303,000	3·1
Greece	501,000	0·7
Algeria	441,000	0·6
Belgium	241,000	0·3
Italy	190,000	0·2
Cuba	164,000	0·1
Canada	52,000	} 0·2
India	43,000	
Japan	28,000	
Other countries	1,208,000	1·6
Total	73,670,000	100·0

It would be impossible for me in the limited time at my disposal to attempt to describe even the main features of the long list of mines which gave the United Kingdom in 1898 its 14,177,000 tons of iron ore, valued at £3,407,000. The principal iron-ore producing districts are Cleveland, in North Yorkshire, yielding 5,786,000 tons, or 40·8 per cent. of the total output of the kingdom; Leicestershire, Lincolnshire, and Northamptonshire yielding 3,950,000 tons or 27·8 per cent., and Cumberland and North Lancashire yielding 2,001,000 tons or 14·1 per cent. Most of the ore from Staffordshire and from Scotland comes from mines also producing coal.

The Cleveland ore, an earthy carbonate, occurs in a bed 10 feet thick in the Middle Lias. It contains on an average 30 per cent. of iron. The mines are worked in a systematic manner, machinery of the latest type being used. Indeed, the only electric rotating-rock-drills in this country are in use in these mines. With one of these drills, of which there are 14 in operation, 70 or 80 holes can be bored per shift, and a yield of 140 tons of ore easily obtained.

In Cumberland and Lancashire the ore, red hæmatite (highly prized for steel making), occurs in huge irregular masses in Carboniferous limestone. It contains on an average 50 to 60 per cent. of iron. The most important mine in the district is that of the Hodbarrow Mining Company, which in 1898 yielded 420,000 tons of ore. Owing to the fact that the extent of ore ground in the sea direction has not yet been fully proved, some difficult engineering problems have had to be dealt with. A sea wall was built ten years ago to reclaim 35 acres of foreshore, and there is now a scheme to build another wall 6,750 feet long to exclude the sea from 170 acres of ore-ground. A curious feature of the mines of this district is the occasional occurrence of fire damp. In a paper contributed to the North of England Institute of Mining Engineers, ten years ago, I suggested that the gas might have been formed by the decomposition of mining timber under water in a manner similar to the formation of marsh gas in ponds. The character of the irregular ore masses of this district was shown to you in the section of the deposit worked at one of Lord Leconfield's mines (Fig. 7, Lecture I.)

In Leicestershire, Lincolnshire, and Northampton, ore is cheaply quarried from beds of brown iron ore of Inferior Oolite age. Many of the quarries are less than 20 feet deep.

The production of black band ironstone from the coal-measures, the value of which was discovered by Mushet in 1801, decreases year by year, notably in Scotland, which in 1855 produced 2,400,000 tons as compared with 824,000 tons in 1898. Among other sources of supply of less importance now than formerly, are the interesting masses of brown iron ore in the Carboniferous limestone in the Forest of Dean, the beds of brown iron ore of the Upper Cretaceous age beneath the basalt beds in Antrim, the veins of spathic iron ore in the Brendon Hills, and the now unworked great vein of Perran, near Truro, which the late Sir Warington Smyth continually endeavoured to bring before the notice of ironmasters. I may add that one of the colliery sinkings near Dover has passed at a depth of 600 feet through a 12-foot bed of Oolitic iron ore, which may eventually prove of economic value.

Such, in brief, are the home deposits from which the British iron ore supplies are

obtained. These supplies are, however, insufficient for the 378 furnaces in blast that in 1898 made 8,609,719 tons of pig iron. A quantity of ore, nearly equal to half the production, has to be imported. The sources from which the 5,468,000 tons, valued at £4,035,000, imported in 1898, were derived, were as follows:—

	Tons.	Per cent.
Spain	4,684,000	86·0
Greece	296,000	5·4
Algeria	199,000	3·5
Italy	115,900	2·1
Sweden	93,000	1·7
France	43,000	0·7
Australasia	8,000	0·1
Turkey	5,000	0·1
Other countries	25,000	0·4
Total	5,468,000	100·0

Within the last few years Great Britain has had to cede to the United States the position it so long held as first in the production of iron ore and pig iron. The rich ores required for the manufacture of steel have become scarcer, and the mines of Bilbao, which, controlled largely by British capital, have supplied the deficiency, are, as I shall show you later, within measurable distance of exhaustion. It will, consequently, not be unprofitable to attempt to consider how the future requirements of Great Britain are to be met. The details that I shall now bring before you will, I think, tend to show that whilst the rich ores of Bilbao and Elba are becoming scarce, there are still large quantities of ore available in the north of Sweden, in the south of Spain, in Algeria, Canada, Cuba, South America, India and China. The cost of carriage is, of course, an important factor, but the great economies which have been and will be effected in transport will diminish this item. The future of the home demand is likely to be affected by the development of the basic process of steel making. Hitherto this process has been developed chiefly in Germany, where there are large supplies of suitable ore. In Great Britain there need be no immediate fear about the supply of the more impure ores suitable for that process.

From the references made to the British iron ore deposits, you will have noticed that iron ore occurs in beds, in masses, and in veins. Beds of iron ore occur in all the strata of the earth's crust from the oldest to the most recent. I should like incidentally to point out that in no other branch of mining is a knowledge of geology of greater value. It is really lamentable to see the way in which money is often wasted in a search for iron ores in situations where a better knowledge of geology would have shown that there was no chance of finding them. The principal beds of iron ore at present mined occur in the following geological formations:—

Archæan.—Dannemora, Persberg, Gellivare, Kiirunavaara, and Luossavaara in Sweden; Lake Superior; Mokta-el-Hadid in Algeria.

Cambrian.—Salem, Madras.

Silurian.—Krivoi-Rog, Southern Russia; Styrian Erzberg, Austria; manganiferous iron ore at Laurium, Greece.

Devonian.—Bakal in the Ural; Carinthia in Austria; Elbingerode in the Hartz; Vezin in the Belgian province of Namur.

Carboniferous.—Cumberland and Lancashire.

Coal Measures.—South Staffordshire; Scotland; Ruhr coalfield, Germany.

Jurassic.—Cleveland, Yorkshire; Leicestershire, Lincolnshire, and Northamptonshire; minette of Lorraine, Luxemburg, and Meurthe-et-Moselle; Beni-Saf, Algeria.

Cretaceous.—Bilbao, Spain; Ilsede, Hanover.

Tertiary.—Elba, Italy.

United States.

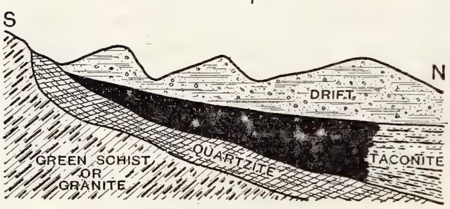
At the present time the conditions and prospects of American competition in the iron trade call for very serious consideration. Undoubtedly the greatest advantage possessed by the United States is that, in the Lake Superior region, they have the most extensive supplies of cheap and rich ore known to exist. It is to the rapid development and unparalleled richness of these deposits that the United States owe their cheap pig iron. The region comprises five ore belts or ranges, and from the beginning of regular mining of ore in 1856 up to January 1, 1899, the total output was 152,359,591 tons. The dates of the beginning of mining at the various ranges was as follows:—Marquette, 1856; Menominee, 1880; Gogebic, 1884; Vermilion, 1884; Mesabi, 1892. The production in 1899 was as follows:—

Range.	Tons.
Mesabi	6,626,384
Marquette	3,757,010
Menominee	3,301,052
Gogebic	2,795,856
Vermilion	1,771,502
Total	18,251,804

In 1890 I visited the Lake Superior district. The Marquette range was then the centre of activity. Since then the discovery of the most remarkable deposits, those of the Mesabi range, has given rise to a rapid increase in the production. The Lake Superior deposits have been exhaustively described in numerous authoritative memoirs, notably in a recent monograph on the Marquette region published by the United States Geological Survey, and in valuable papers by Horace V. Winchell, A. P. Head, J. Birkinbine, F. W. Denton, Brooks and Pumpelly, Wadsworth, Van Hise, and many others who have done much to unravel the complex structure of these ore fields.

The iron ore ranges are situated chiefly in the States of Michigan and Minnesota. The beds occur in rocks of pre-Silurian and probably of pre-Cambrian age, the determination of the geological age resting solely on structural evidence. From Fig. 14, a cross section

FIG. 14.



through the Mesabi range, it will be seen that the ore bed lies on quartzite, below which is green schist or granite, with surface drift above the bed. The ore is chiefly specular iron and brown hæmatite, containing 63 per cent. of iron, 0·04 per cent. of phosphorus, and 10 per cent. of moisture. As to the genesis of the ores there has been much speculation. The principal theories are (1) the obsolete one that the ores are of eruptive origin, (2) that they are mechanical sediments, and (3) that they are of chemical origin. Under the third head, the chemical action may have been that of original precipitation or that of replacement or segregation of chemical materials by the substitution of iron oxides. Mr. Winchell inclines to the theory of oceanic precipitation advanced by him in 1889. He considers, however, that there is no reason to suppose that all the iron ore deposits were formed in the same way.

In mining the deposits four methods are employed, known respectively as (1) overhand stoping, (2) caving, (3) milling, and (4) steam-shovelling.

In the overhand stoping method, a shaft is sunk, and drifts driven to the ore, which is worked out upwards and allowed to fall by gravity into wagons that convey it to the shaft.

In the caving method, a series of levels connected with the shaft are simultaneously worked. As the ore is removed from the portion of one level, the superincumbent rock is allowed to cave in upon the ore below. Before caving, boards are placed over the bottom of the drift to keep the sand from mixing with the ore mined from the next lower series of drifts.

In the milling method, the surface earth is removed, and the ore drawn down through rises into drifts some distance below the top of the ore. In this way large craters are formed. This system is adapted to shallow deposits of soft ore.

Steam-shovelling is the cheapest method. It is used in the Mesabi range in cases where the ore is earthy and near the surface. At the Oliver mine the face of iron ore is 50 feet high, and the 90-ton steam shovel, with a 2¼-cubic-yard digger, is capable of loading 500 tons of ore per hour into railway waggons, at a cost of 10d. a ton.

The steam shovel is also largely used for handling ore. The photograph (Fig. 15, p. 709), for which I am indebted to Mr. Dunbar D. Scott, shows a Bucyrus steam shovel working at the end of No. 7 stock pile at Norrie mine, Ironwood, Michigan. During the winter the ore is stocked in piles at each shaft, and loaded into the railway waggons by steam shovels at a cost of about a penny a ton. In the spring this No. 7 pile contains about 100,000 tons of ore. Before the introduction of steam shovels the ore was loaded by wheelbarrows at a cost of 2½d. to 4d. per ton.

In underground mining it is frequently necessary to fill the excavations with waste rock, a method that is often more economical than timbering. When timbering is used it is of the square set type, the square sets, which are cut by machinery at the surface, being 7 ft. 6 in. from centre to centre of the legs.

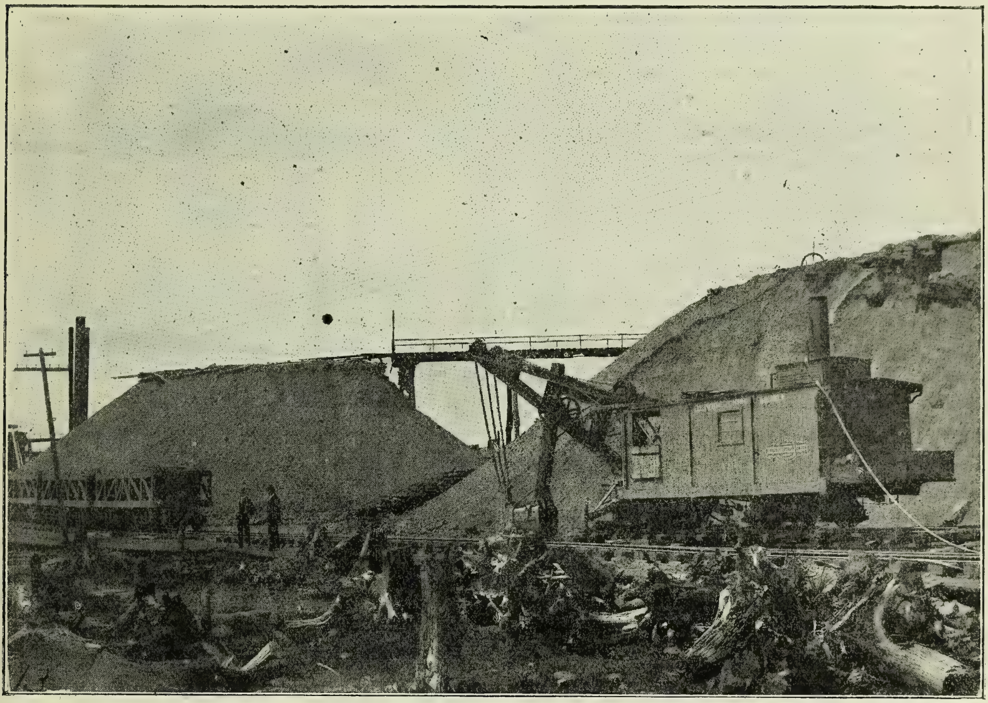
In the Lake Superior district some of the mines which have produced enormous quantities of ore show signs of depletion, but new discoveries have increased the reserves in sight. Indeed, Mr. Winchell thinks that it is not unreasonable to assert that the Mesabi range alone will produce 500,000,000 tons of ore before it is abandoned. A remarkable feature of the Lake Superior mines is that most of the ore has to be carried by rail and water for a distance of over 800 miles to the

blast furnaces. The iron-producing district of Birmingham, Alabama, is the chief centre now dependent upon local ores. Other blast furnaces in the Southern and Eastern States also obtain all or a portion of their supplies from mines within short distances.

Lorraine and Luxemburg.

The iron ore production of Lorraine represents more than half of all the iron ore raised in Germany. It is derived from the so-called *minette*, beds of oolitic brown iron ore, covering an area 60 miles long and 18 miles wide, extending from the Grand Duchy of Luxemburg along the left bank of the Moselle as far as Nancy. There are five main seams, the ore containing on an average 36 per cent. of iron, 5 to 20 per cent. of lime, 7 to 34 per cent. of silica, 2 to 10 per cent. of alumina, and 1·7 per cent. of phosphoric acid. Owing to the high percentage of phosphorus, which makes the iron obtained brittle, the ore was of little value, until twenty-one years ago the basic method of making steel was brought into practical use by Thomas and Gilchrist. This revolutionised the iron trade and rendered the *minette* deposits of vast importance to the German iron industry. The importance of the discovery to Germany is shown by the fact that, at the present time, that Empire furnishes two-thirds of the world's supply of basic steel. Moreover the slag obtained, owing to its high percentage of phosphorus, is an excellent fertiliser for agricultural purposes, and commands a ready sale. The rapidity of the development of Lorraine has been remarkable. In 1872 the output of iron ore was 365,000 tons valued at £40,000, whilst the present output is 6,000,000 tons, valued at £700,000, or in other words sixteen times as much. According to the most recent calculations there are in Lorraine 2,000,000,000 tons of workable ore still untouched. In the Grand Duchy of Luxemburg there are 99,585,000 tons available, and across the French frontier there are large areas still unworked in the department of Meurthe-et-Moselle.

Fig. 15.



Steam Shovel at Norrie Mine.

Spain.

Although Spain produces a comparatively small amount of pig iron, it is rich in iron ores which are for the most part smelted in

England. The principal mines are situated in the Bilbao district in the north of the kingdom. The old fame of the iron and and steel made from Bilbao ores is attested by the term *bilbo*, commonly used by Elizabethan writers for a rapier. The north coast of Spain, in the province of Biscay, is composed chiefly of rocks of Cretaceous age. The iron ore occurs in beds that follow the configuration of the limestones and sandstones in which they lie. The area, within which the beds occur, measures 15 miles in length and 2½ miles in width. The ore raised in this area is known as Bilbao ore, and is mostly shipped at various places on the Bilbao river. Four classes of ore are distinguished :—

1. *Vena*, a soft purple compact and often powdery red hæmatite.

2. *Campanil*, a compact and crystalline red hæmatite, often accompanied by rhombohedra of carbonate of lime.

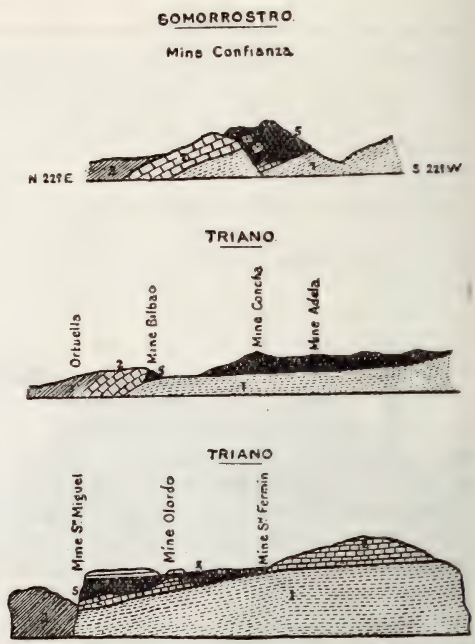
3. *Rubio*, a brown hæmatite usually mixed with siliceous material ; and

4. *Carbonato*, a grey granular and siliceous or a creamy-white laminated and crystalline spathic iron ore.

Vena is the purest of these ores and was in former times the only one used for the local Catalan forges. Campanil on account of its freedom from phosphcrus is the most valuable ore, but it is now nearly exhausted. Rubio, on the other hand, is the ore that is met with in largest quantities. It is, however, often associated with iron pyrites, which renders careful selection necessary. Unlike campanil, it is usually found uncovered. I remember seeing in 1888 some bold outcrops of this ore. With the extension of mining operation this picturesque feature of the landscape had entirely disappeared when I revisited the district in 1897. Carbonato is usually found below the other ores, and, after calcination, it finds a ready sale. The accompanying sections (Figs. 16, 17, 18) show the mode of occurrence of the ore, 1 being sandstone, 2 hard limestone, 3 argillaceous limestone, and 5 iron ore. Mr. William Gill, whose papers contributed to the Iron and Steel Institute furnish the most trustworthy information regarding these deposits, is of opinion that they were formed by hydro-thermal action. Springs charged with ferrous carbonate, dissolved by reason of an excess of carbonic acid, acted on the limestone beds; and as the carbonate of lime is more soluble in water saturated with carbonic acid than the ferrous carbonate, it has been replaced by the latter, which in its turn has been changed into hæmatite by a subsequent loss of carbonic acid and absorption of oxygen.

Seven districts are distinguished. The principal or Somorrostro district containing two huge beds of iron ore, that of Triano on the west, and that of Matamoros on the east, yields the largest quantity of ore, some 3,500,000 tons annually. In these cases spathic iron ore overlies the limestone at the deepest points, while in the higher portions red hæmatite is deposited immediately on the limestone. The

Figs. 16, 17, 18.



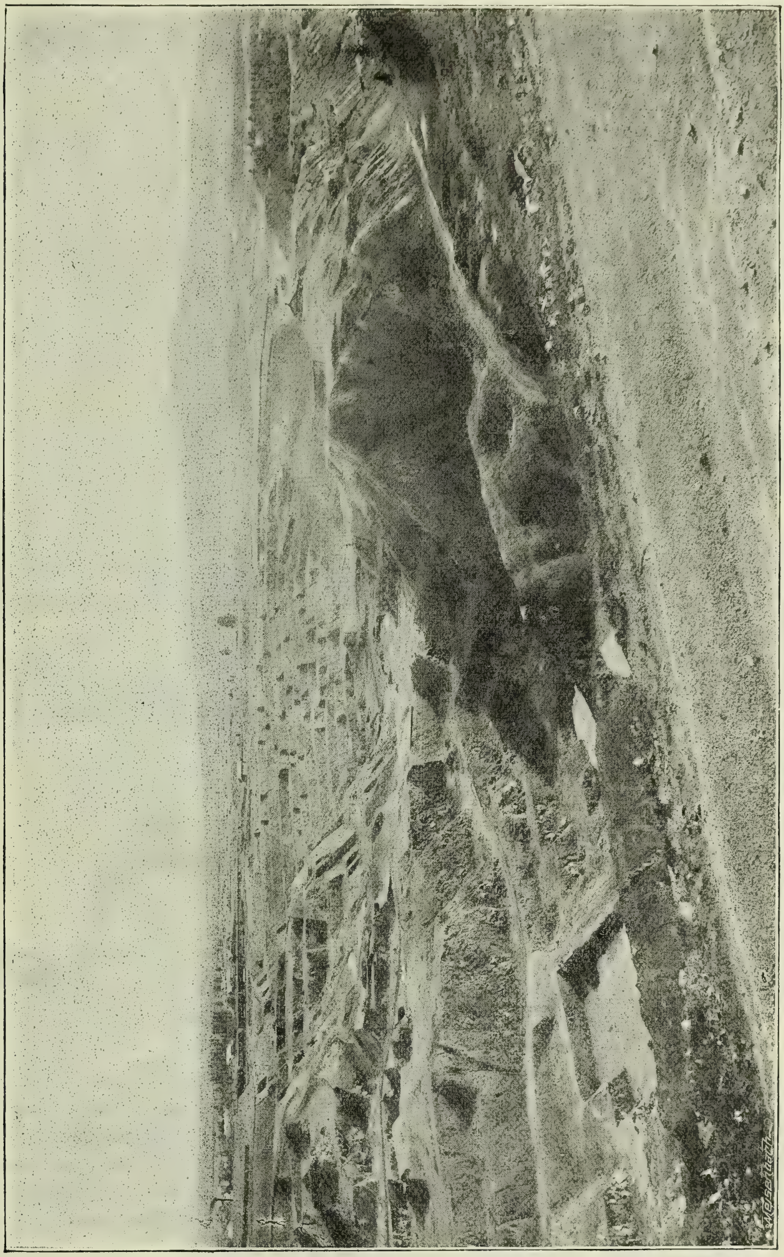
brown hæmatite lying above, in both cases, encloses numerous crystals of spathic ore. The ore is worked by quarrying. The ore mass at Monte Triano has an irregular shape, and extends for a length of 3,080 yards, while its thickness increases from a few yards up to 30 yards. The districts of Galdames, Sopuerta, Ollargan, Abondo, Alonsotegui, and Gueñes, also yield large quantities of ore. Altogether the seven districts in 1899 furnished 6,000,000 tons of ore.

Analyses of ore from the Orconera Company's mines show that vena contains 55·97 per cent. of iron, campanil 54·62 per cent., rubio 54·80 per cent., grey spathic ore 43·70 per cent., white spathic ore 45·73 per cent., and calcined spathic ore 62·85 per cent. The approximate output of the Bilbao district from the commencement of modern mining operations in

1860 to the end of 1899 has been about 88,000,000 tons, and while it is obvious that the present enormous output cannot be maintained for ever, it may reasonably be expected that Bilbao, will for several years to come, continue to be the most important source of Great Britain's supply of iron ore of high quality.

Besides the Bilbao beds there are many other important iron ore deposits in Spain. The province of Santander, long celebrated for its zinc ore deposits, has of late years become an important sourse of supply. The iron ore is found chiefly in superficial deposits of clay containing concretionary nodules of hæmatite. It is usually richer in iron than Bilbao ore, but higher in phosphorus and sulphur. Important deposits are also worked in the south-east of Spain, not-

Fig. 19.



Open cast Workings at Nischne-Taguil.

ably in the Sierra de Bédar, where brown hæmatite beds occur in association with limestone. The ore is carried by an Otto aerial ropeway 9½ miles in length to the port of Garrucha.

FRANCE.

France possesses iron ore deposits in great variety, the principal one being the beds of brown iron ore, occurring in some cases in the crystalline limestones of the Pyrenees and in others in the Jurassic and Cretaceous strata of the north-east of the Republic. To the important beds of oolitic iron ore in the department of Meurthe-et-Moselle reference has already been made. Over 80 per cent. of the French output of iron ore is derived from this source.

In Algeria there are several well-known mines which have long been successfully worked, but the output now shows a tendency to decrease. The ores are exported from the ports of Benisaf and Bona, chiefly to England, smaller quantities going to Germany, France, and Belgium. The deposits occur chiefly in association with eruptive rocks. The Mokta-el-Hadid deposit consists of thick beds of magnetite in Archæan rocks. At Tafna, in the province of Oran, beds of red and brown hæmatite occur in Liassic limestone. The ore is also met with in irregular masses. The Beni-Saf mines are the most important in this district. At Rar-el-Maden mines of a very promising character have recently been opened. The ore, a manganiferous brown hæmatite, averaging 51 per cent. of iron and 7 per cent. of manganese, is quarried from a massive deposit of considerable size. The mine is connected with the harbour by a wire ropeway, 4¾ miles in length, conveying 20 tons of ore an hour. From December, 1898, when the first shipments were made, to July last, 38,000 tons of ore were exported.

RUSSIA.

The greater portion of the iron ore produced in Russia is obtained from the Ural region. Iron ores occur in many places on both sides of the mountains, and present marked contrasts as regards composition, those on the western side being principally limonite and spathic ores essentially of a stratified character, while in the east they are masses of magnetite associated with igneous rocks. The most important of the former deposits are those of Bakal which form large irregular beds in dolomitic limestones, schists and quartzite of lower Devonian age. The ore, we are told by Mr. H. Bauerman, who in 1898 gave a detailed description of the Ural mines to the Iron and Steel Institute, is an extremely pure limonite, yielding 60 per cent. of iron, and although the deposits have been worked for 150 years, the whole supply of 100,000 tons per annum is obtained from open-cast workings. In the Eastern Ural the principal mines are near Nischne Taguil. The most important deposit is at the hill known as Wissokai Gora, which covers about a square mile; the hill being made up of alternations of eruptive rocks and limestone with bands of magnetite. The workings, as will be seen from the general view (Fig. 19, p. 711) borrowed from Mr. Bauerman's paper, are entirely open-cast. The ground is laid out in terraces 20 feet apart, the ore being broken down by pick and crowbar or by blasting, the waste being carted to the spoil banks at a distance, while the ore is piled along the railway, and distributed by narrow-gauge railways to the different works. The output of the mines is 120,000 tons yearly. About thirty miles north is the famous Iron Mountain of Gora Blagodat. This is a ridge, rising 500 feet above the plain, made up of eruptive rocks containing magnetite in masses of irregular size and shape. The original anticlinal fold has been considerably modified by faulting, the ore bands being thrown down to the eastward (Fig. 20), leaving a barren

FIG. 20.

GORA BLAGODAT.

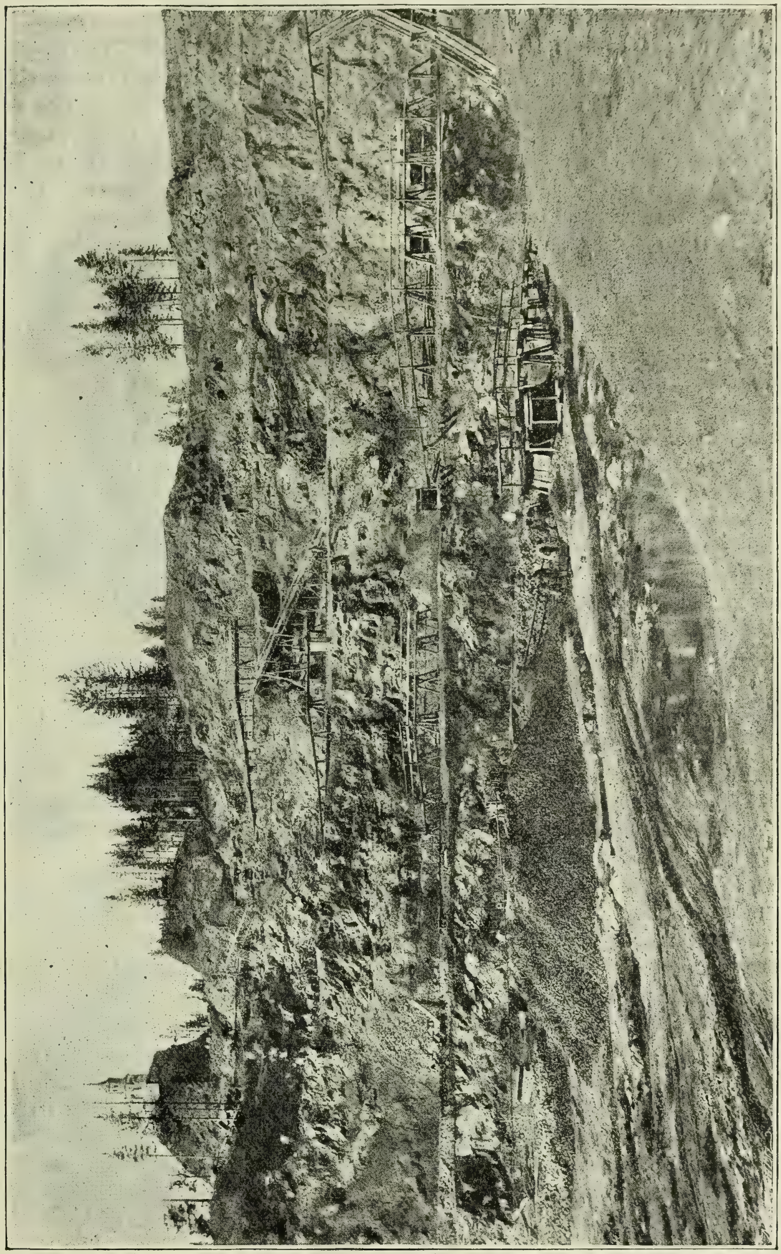
cone of porphyry on the summit upon which the observatory shown in Fig. 21 (p. 713) has been built. The ore is a hard magnetite containing 56 per cent. of iron, and its continuity has been proved by diamond boring to a depth of 700 feet below the surface. The annual output is 85,000 tons.

Next in importance to the Ural is the district of South Russia, which has of late years taken a prominent position as an iron-producing centre. The principal deposit is that at Krivoi-Rog, in the government of Cherson, where beds of hæmatite and magnetite occur in highly-

inclined quartzite beds. The ore yields over 60 per cent. of iron. The output is about 200,000 tons annually, and at the present rate of consumption it is believed that the deposit will not last for more than 15 years.

A remarkable example of the occurrence of iron ore in masses is afforded by the Styrian Erzberg, the largest deposit of spathic iron ore in the Northern Alps. The Iron Mountain is conical in shape, the highest point

FIG. 21.



IRON ORE WORKINGS AT GORA BLAGODAT.

AUSTRIA-HUNGARY.

Austria has three important centres of iron ore mining, in Bohemia, Styria, and Carinthia. The largest output is obtained from Styria, Bohemia follows, and then Carinthia.

being 4,800 feet above sea-level and 3,000 feet above the town of Eisenerz. The deposit nearly follows the contour of the ground, so that at one time it was thought that the entire mountain consisted of solid ore. It

is really a bedded mass from 60 to 180 yards in thickness, included between limestones resting on Devonian schists and overlain by Triassic slates. The ore is a finely granular spathic carbonate containing 40 per cent. of iron. When altered by weathering it changes to brown hæmatite averaging 54 per cent. of iron. This was the ore sought by the primitive miners as best suited for direct reduction, and the fissures were laboriously followed by small tortuous levels driven by hammer and wedge, the unweathered ore being thrown aside. The ancient workings date back to remote ages of antiquity, The Iron Mountain was situated in the Roman province of Noricum, and the excellence of Noric iron is frequently dwelt upon by classic writers. In those days the mines were worked by convicts, slaves, and prisoners of war. The ancients regarded mining as an unworthy occupation, and Tacitus warmly expresses his contempt for the Goths who, as freemen, condescended to work in iron mines: "*Gothini quo magis pudeat, et ferrum effodiunt.*"

On the Eisenerz side of the mountain the workings are carried on in the open in regular terraces, covering an area of 78 acres. At the time of my visit in 1885 there were 26 terraces being worked with a total height of 1,500 feet. There are now, I understand, about 50 of these terraces, their height varying from 9 to 13 yards. On the Vordernberg side the workings lie 3,500 feet and more above the sea-level, so that quarrying can be carried on only in the summer. Much of the ore was consequently obtained by underground mining. The extensive underground workings are now mostly abandoned and replaced by open working. In 1898 the Styrian Erzberg yielded 998,500 tons of spathic iron ore, or 57·5 per cent. of the total iron ore production of Austria.

In Hungary, spathic iron ore and magnetite are the principal ores. The deposits may be divided into two great divisions, the first, or north-western division, including the spathic ore deposits in the crystalline rocks of the Tatra Mountains, and the second, or southern division, the magnetite masses in the crystalline rocks of the Banat. Among the mines of the first division the more important are those of Vashegy, in Gömör county, which yields 185,000 tons yearly. At Varin and Botcza, in Szepes county, the bed of iron ore furnishes 100,000 tons annually; while in Hunyad county there is the most extensive brown iron ore bed in Hungary. The largest deposit is that owned by the Hungarian Government at Gyatár, which is over 500 feet thick, and consists almost entirely of limonite. It furnishes 138,000 tons of ore annually. In the southern division the most important mines are those at Vaskö and Dognáeska, which produce annually 101,000 tons and 29,000 tons respectively.

Sweden.

In Sweden iron ores occur chiefly in beds of lenticular shape parallel to the enclosing strata. The ore is mostly magnetite, often containing as much as 10 per cent. of manganese. Phosphorus is usually absent. In some cases red hæmatite is met with as hard and massive specular iron ore in veins in quartzite and granite. Brown iron ore of recent age also occurs, extending over the bottom of lakes or in the form of bog iron ore. The production of lake and bog ores is now very insignificant. Of the mines producing ore containing very little phosphorus the following may be cited as typical examples:—

1. In the province of Dalecarlia and Westmanland, a district noted for the rich copper deposit at Falun, magnetite occurs in veins and masses in gneiss, and is mined at Bispberg and Norrberg. At the former locality the mines have been worked for more than 500 years, a charter relating to the mines, dated March 22, 1388, being still in existence. The ore mined contains 70·7 per cent. of iron and 0·004 per cent. of phosphorus. The output in 1898 amounted to 12,741 tons. The Norrberg mines were worked at a still earlier period, the oldest document relating to the mines dating back to 1303. In 1898 the production was 7,782 tons.

2. In the province of Wermland, magnetite beds are worked at the mines of Persberg, Taberg, and Langban.

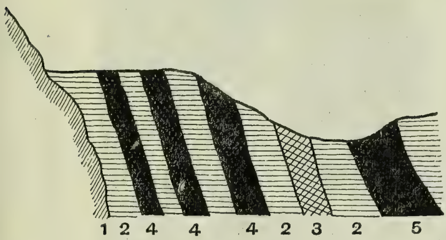
3. In the province of Upsala are situated the far-famed Dannemora mines, where the beds of magnetite form a huge deposit which has been worked since 1481 along the outcrop for a distance of more than a mile. In the middle the deposit is more than 180 feet in thickness. The open workings have reached a depth of 650 feet. The annual output is 50,000 tons, six steam-engines of 218 horse-power, and four turbines of 136 horse-power being used for winding and pumping. Here, in 1805, the first steam-engine for pumping was used in Sweden.

4. Near Jönköping there is a deposit of great geological interest which deserves mention, although mining is not now being carried on. This deposit, the Taberg (not to be confused with the Taberg mines in Wermland),

forms a hill rising 400 feet above the surrounding gneiss, and covering an area of 312,000 square yards. The entire mass consists of a granular crystalline mixture of magnetite and olivine, but as it does not contain more than 31 per cent. of iron, it cannot at the present time be worked at a profit. It is to be hoped that eventually some economical method of concentrating the ore will be found.

5. Of the iron ore deposits rich in phosphorus, those at Grängesberg are now the most productive in central Sweden. These deposits, which include both specular iron ore and magnetite, occur in detached lenticular beds in granulite (Fig. 22, in which 1 represents granite, 2 granulite, 3 gneiss, 4 magnetite rich in phosphorus, 5 iron ore poor in phosphorus), extending for $2\frac{3}{4}$ miles,

Fig. 22.



with a maximum breadth of one-quarter mile. Mining operations date back to the year 1600, but the most important deposits on the eastern side remained untouched, their working being prohibited on account of their highly phosphoric character, until the discovery of the basic method of steel making in 1879 rendered it possible to utilise them. Since 1884 there has been an important export trade in them, chiefly to Germany. The ores exported are remarkable for their uniformity in character, giving a high yield—62 to 64 per cent. of iron and 0·9 to 1·5 per cent. of phosphorus, while the silica and earthy bases are in approximately self-fluxing proportions Hitherto the export ores have been mined open-cast, but the depth has now become too great to be safe. The ore, broken down by boring and blasting with dynamite, is loaded into waggons, which are run into cages and lifted by electric winding engines to the surface; there it is discharged into railway waggons that carry it to the shipping port of Oxelösund, 160 miles away. The arrangements for transmitting power at the mines constitute a feature of special interest. Electric power is used, obtained from a waterfall of 150 feet, working turbines in a power-station at Hellsjön, $7\frac{1}{2}$ miles distant from the mines. The total output of the mines in 1899 was 600,000 tons.

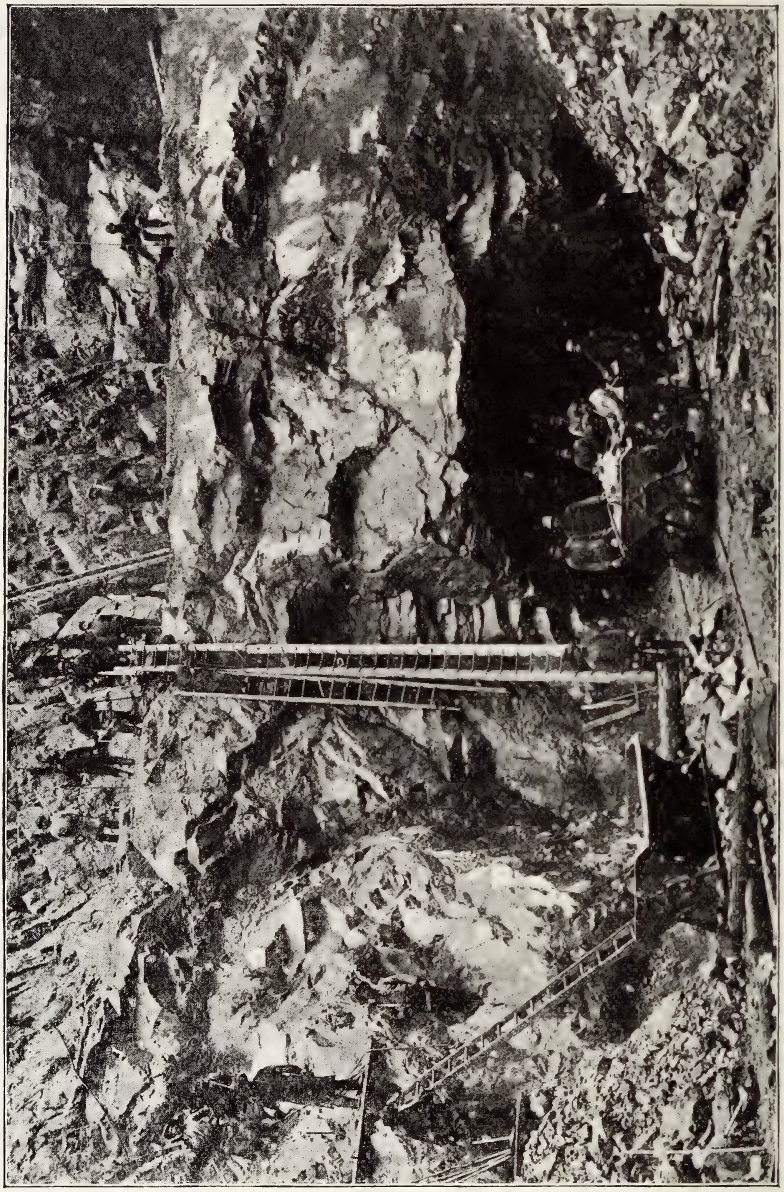
6. The remarkable iron ore deposits at Gellivare are exceedingly rich and extensive, but owing to their geographical position (lat. 67° 11 N.) at a distance of 100 miles from the Gulf of Bothnia, have only since 1892 become of economic importance. The mines are reached by a railway line 132 miles long from the port of Luleå. The deposits consist of a number of bedded lenticular masses, varying in size, and covering an area of $3\frac{1}{2}$ miles in length and $1\frac{1}{2}$ miles in breadth. They occur in red gneiss, and consist essentially of magnetite. The ores are of two kinds, one with a guaranteed maximum of phosphorus and the other with a guaranteed minimum, the former being due to an admixture of apatite. They are classified into five grades: A. with 68·69 per cent. of iron and 0·05 per cent. of phosphorus; B. with 67·68 per cent. of iron and 0·1 per cent. of phosphorus; C. with 65·67 per cent. of iron and 0·8 per cent. of phosphorus; D. with 63·64 per cent. of iron and 0·7 per cent. of phosphorus; and E. with 60 per cent. of iron and 1·5 per cent. of phosphorus. The production of the Gellivare mines in 1899 amounted to 920,997 tons of magnetite, and it is estimated that there is enough ore above the surface level to last for 200 years.

Hitherto the mines have been worked almost entirely open-cast, the ore from the quarries at the top of the hills being lowered by self-acting inclined planes to the railway. The largest working is the King Oscar mine. The adjoining mine, the Sofia, is also of considerable size, and is worked at two levels 50 feet apart. The Hertigen, Kapten, and Frederika mines (Fig. 23, p. 716), where the purest ore is obtained, are in process of development by underground mining. Other important mines are the Välkommen and Josefina mines. From the mines the ores are carried to the screening-house and classified for loading into the main line waggons carrying 25 tons. The shipping station is near Luleå, where the ore brought down in winter is stored and reloaded for shipment. The loaded waggons are raised by a hydraulic lift carrying a lattice-hung platform with overhanging ends, carrying three waggons which are brought successively opposite the loading shoots. For larger vessels a new loading stage has been built. This is a high timber trestle carrying a railway rising 1 in 50, up which the waggons are drawn by locomotives and dis-

charged by counter-balanced shoots leading directly into the steamer's hold. The arrangements are described in detail in Mr. H. Bauerman's paper on the subject, recently read before the Iron and Steel Institute. Only ores of the classes A to D are shipped, the E class and the smalls are treated in the new separating works at Luleå. The magnetite and hæmatite are separated by magnetic concentration, and the lighter refuse is subsequently converted into a fertilizer known as Wiborgh's phosphate, sodium tetrabasic phosphate.

On the way to Victoriahavn on the ice-free west coast of Norway, the railway now being constructed from Gellivare passes the deposits of Kiirunavaara and Luossavaara, which resemble in character those at Gellivare. The similar deposit of Svappavaara also contains a large amount of ore, but being off the railway route can be regarded only as a reserve. Careful measurements show that at

Fig. 23



Lower Workings, Frederika Mine.

Kiirunavaara the amount of magnetite above the level of the Luossajärvi Lake is 215,000,000 tons, and that at Luossavaara 18,000,000 tons. The amount below the level of the lake is unknown. The ore contains 60 to 70 per cent. of iron.

The shipments of Gellivare ore from the port of Luleå in 1899 amounted to 920,997 tons, of which 705,786 tons went to Germany and 123,407 tons to England. In view of the immense amount of rich ore available at Gellivare, Kiirunavaara, Luossavaara and other localities within the Arctic Circle, there is no doubt that when the Swedish-Norwegian railway is completed there will be a rapid increase in the amount of ore exported to Great Britain. Luleå is 1,550 miles from Middlesbrough whilst Bilbao is 1,030 miles, and on account of the ice at Luleå the traffic has to be done during five months of the year. The new railway will be carried to Victoriahavn on the Ofoten Fjord, which is always free from ice as it lies in the path of the Gulf Stream. The Kiirunavaara and Luossavaara deposits are 115 miles from Victoriahavn, nearly the same distance as Gellivare is from Luleå. Middlesbrough is only 1,170 miles from Victoriahavn, and by the opening of this route Great Britain will secure an advantage over Germany and Austria.

In the iron ore deposits of the Arctic Circle there are ample supplies of ore available to meet the increased demand that is likely to arise. In the deposits of iron ore free from phosphorus in other parts of Sweden, which are not available for export, it is open to question whether the yield will not decrease as greater depths are attained. The Swedish iron mines are rarely more than 300 yards in depth. Many mines have been abandoned long before that depth was attained, because the deposits have thinned out or have decreased in yield. In the province of Wermland the decrease in yield is noteworthy. The output of the province fell from 85,000 tons in 1866 to 80,000 tons in 1898, and the number of mines working fell from 70 to 32.

In the foregoing descriptions of the Swedish iron ore deposits, I have summarised part of a paper I read before the Society in 1897,* and have described the deposits at some length. My reason for doing so is that there appears to be a considerable amount of misapprehension as to the magnitude of the Swedish mining and metallurgical industries. Even so trustworthy an authority as the *Times*, in a leading article on Scandinavian politics, published on October 19th, 1899, asserted that Sweden had no manufactures nor commerce, and had almost stood still for the last 85 years. The statistics I have given will, I think, serve to show the injustice of such statements.

Other Countries.

The production of iron ore in the other countries enumerated on the list is comparatively small. Several of them, however, offer a promising field for development. Next to Spain, Greece is at present the source from which we import most iron ore, nearly half the output of the country being exported to Great Britain. Mining is still confined to the small islands of the Cyclades and to the coast, facilities for transport in the interior being quite inadequate. The ores exported contain on an average 52 per cent. of iron. They consist of iron carbonate, hæmatite and magnetite, forming irregular masses in limestone. Most of them contain manganese, those of Seriphos yielding as much as 8 per cent. Throughout the country there are extensive ancient slag heaps showing that the iron ores not utilised at present were extensively mined in ancient times.

In Belgium iron ores occur in limestone, and in Devonian beds. They are mined in Namur, Liége, and Luxemburg. The most important bed of hæmatite in the first of these provinces is that at Vézin. The province of Luxemburg contains beds of iron ore of Jurassic age identical with those so extensively worked in Lorraine, the Grand Duchy of Luxemburg, and the department of Meurthe-et-Moselle.

In Italy, the iron mines of the island of Elba, the "Insula inexhaustis chalybum generosa metallis" of Vergil, have been worked for more than 4,000 years, their origin being buried in the remotest antiquity. Recent discoveries of prehistoric implements seem to indicate that ore was excavated before the end of the Stone Age, and give plausibility to the statement that weapons made from Elban iron were used at the siege of Troy, B.C. 1280. Diodorus Siculus describes the smelting of the iron ore for which Elba was famous in his time, whilst Pliny and Aristotle refer to the wide distribution of iron forges throughout the island. Mr. Herbert Scott, who published in 1895 an exhaustive description of the mines, considers that the ore excavated during the 3,000 years before 1751 was at the rate of 4,000 tons annually. From that date to 1851 the annual

* *Journal of the Society of Arts*, vol. xlvi., p. 61.

production was 14,000 tons. From 1851 to 1881 the average annual output rose to 120,000 tons, while in 1811 the production was 400,000 tons. Fearing that the future of the mines would be endangered, the Italian Government restricted the exports to 200,000 tons, and later, in 1885, to 180,000 tons annually, and at the present time to 160,000 tons. The amount of ore still available was ascertained by the Government in 1884 to be 8,000,000 tons. Since then some 2,700,000 have been excavated, so that at the present time there are 5,300,000 tons yet remaining. The deposits are superficial, and have been proved to be of no great depth. The masses rest on schists, conglomerates, and gneiss with which they have not intimate connection, having been superficially deposited in cavities in comparatively recent geological times. Phosphorus has been found in some of the deposits which are consequently neglected, but, as a rule, the Elban ore is exceedingly pure and rich, cargo samples giving as much as 66 per cent. of iron. According to the terms of the present lease, the concessionaire must not export more than 160,000 tons a year, and is obliged to supply the Italian iron masters with at least 40,000 tons. In 1898 the shipments amounted to 228,000 tons, of which 110,000 tons came to England.

In Cuba the extensive deposits of iron ore have long been known, but little attention was paid to them by the Spaniards. They consist of masses of hæmatite. Mining operations are confined chiefly to the province of Santiago, where the three companies at work are the Juragua, Spanish American, and Sigua. From 1884 to 1897 they produced 3,444,000 tons. All the ore is worked open cast. Since the war the mines have started again, but there has been some difficulty in getting an adequate supply of labour. The Cuban ores are of vital importance as a source of supply for the iron-works of the eastern United States. A portion of the output, however, finds it way to this country.

Canada is rich in deposits of magnetite and specular iron ore occurring in thick beds in Archæan rocks. Many of these have been worked on a fairly extensive scale, and fresh discoveries are constantly being made.

In Newfoundland beds of hæmatite are quarried on a large scale, steam rock-drills and dynamite being used. The output of ron ore from Belle Isle now reaches 2,500 tons a day, the average percentage of iron being 55. The out-crop of the deposit is 90 yards in width and 3 miles in length. The deposit is covered with 3 yards of earth which is removed with the aid of dynamite. Up to the present time 35,000,000 tons of ore have been opened up. Mining has been carried on since 1892.

The abundance and extent of the iron ore deposits of India are such that it is impossible for me in the time available to attempt to describe them. Owing to the fact that all attempts to establish an iron industry in India hitherto have contemplated the use of charcoal as fuel, the output of the iron ore mines has been insignificant. Major R. H. Mahon has, however, recently submitted a report to the Government on the feasibility of using coke as fuel, and this report may perhaps lead to a development of the iron ore mining industry. Many of the deposits contain great quantities of ore of extreme purity. In the peninsular area, magnetite occurs in beds and veins in most of the regions where metamorphic rocks prevail. The most important deposits are those of the Salem district, in the Madras Presidency, where enormous quantities of pure ore with 60 per cent. of iron can easily be obtained. In the eastern area large supplies of ore with 47 to 50 per cent. of iron are raised in the Damuda valley for the Barakar ironworks. In the central region there are enormous deposits of specular iron ore in the Chanda district, and in the southern region the opening up of railway communications in the Nizam's territory may put the rich iron ore deposits, recently described by Mr. Syed Ali Bilgrami, in contact with the coal of the Singareni field. There are many other rich deposits of iron ore in India. These few examples will, however, suffice to show that in that country abundant reserves of good ore are at hand, should the conditions of transport obtaining in the future render them available for use in Great Britain.

Japan is poor in iron ore. Veins occur at Iwate, and magnetic iron sands are abundant in Shimane, Tottori, and Hiroshima. These three districts produce a little iron, but it is made by ancient processes. The production of of iron ore in the empire does not exceed 28,000 tons.

In China iron ore is of frequent occurrence. The report by Mr. J. H. Glass on the concessions of the Pekin Syndicate in the provinces of Shansi and Honan, published in 1899, tends to show that the account given by Baron von Richthofen, of the enormous iron resources of the region, is absolutely true. The iron industry has flourished for more than a thousand

years, the ores used consisting of limonite and hæmatite occurring in beds in shales and sandstones of Carboniferous age. The native methods extract 25 to 35 per cent. of iron from these ores.

In Australasia important deposits of iron ore are found in New South Wales, in proximity to coal and limestone. At Mitlagong magnetite containing manganese, nickel, and rhodium, occurs in a vein four yards in thickness. Iron ore is also mined and smelted by the Eskbank Ironworks at Lithgow. In Victoria, iron ore, chiefly hæmatite and limonite in veins, is widely distributed.

In South America, little is known of the iron ore deposits. Brazil possesses rich deposits in Minas Geraes, notably lenticular masses of magnetite at Saõ Paulo, whilst beds of itabarite, a mixture of specular iron ore, magnetite, and quartz, are widely distributed, and often very rich in iron. In Venezuela there are extensive iron ore deposits on the Orinoco now being mined by American capitalists. Chili, too, is rich in iron; while in North America, Mexico contains iron in most of the mining districts. The Cerra del Mercado at Durango, for example, consists almost entirely of magnetite.

Miscellaneous.

TECHNICAL EDUCATION.

The Permanent Committee for the International Congresses on Technical Education have drawn up a series of regulations for the organisation of future congresses. Such congresses may be arranged either by a Government, or by local authorities, or by associations. Each congress may deal either with the two subjects of Commercial and Technical Education, or with either of these subjects separately. The cost of each congress to be provided for by the organisers. It is to be the duty of the Permanent Committee to deal with any questions arising during the interval between two successive congresses. It is also the duty of the Committee to consider any propositions which may be made for holding the congresses, to fix the date and place for each congress, to prepare a programme for it, and to carry out its resolutions.

The Committee is to be composed of delegates from all the countries taking part in the congress at which it is re-appointed. The maximum number of representatives from each country is six. Half the representatives of each country retire after the holding of the congress, but are eligible for re-election. The selection of the retiring members on the first occasion is to be made by ballot. The Committee may select its own headquarters and the places for its meetings. It must hold a meeting about six months before the holding of each congress.

THE HISTORY OF PHOTOGRAPHY IN NATURAL COLOURS.

The *British Journal of Photography* gives the following translation of a paper on this subject, read by Professor Barbieri, of the photographic school of the Zurich Polytechnic, at the annual meeting of Swiss Photographic Societies held not long ago in Lucerne.

Two processes have been employed up to the present time for obtaining photographs in natural colours. The older of the two is direct; the other adopts the method of preparing three colour sensation negatives. one for the red, one for the blue, and one for the yellow. The print is thus obtained in every tint by the mixture of these three colours.

Seebeck was the first to obtain direct coloured prints. He found that silver chloride not only deepened in tint but became coloured when exposed under coloured glasses. A more important observation was that of Becquerel, who found that a more exact reproduction of the colours was obtained by combining chlorine and silver by electrical means. Becquerel also made the observation that the coloured result was more nearly perfect if the film were submitted to a preliminary exposure in daylight. This fact is an indirect proof that the reproduction of the colours depends more upon the action of light upon the subchloride than upon the normal chloride.

Poitevin improved on Bacquerel's process by adding to the sensitive mixture substances to increase the sensitiveness to colours without, however, producing any action on the sub-salt so essential to the process. The method used by Poitevin was afterwards very considerably improved by the well-known photo-chemista, Krone, Kopp, Veress, Valenta, and others.

Next in the history of the direct process come the experiments of Lippmann who followed out experimentally the process described by Zenker in 1868. This process consisted in employing a film sensitive to all colours and a mirror of liquid mercury. The rays passing through the film fall upon the mirror, by which they are reflected through the film. The reflected rays show the interference produced by the film. Lippmann's coloured prints are thus not formed by any pigment. Their colours are visible only when they are viewed by reflected light, but they are none the less permanent. Others have taken up and improved Lippmann's process. I may mention Krone, Valenta, and Lumière. The last especially has produced since 1892 landscapes and portraits by Lippmann's process.

It was Lippmann who conceived the idea of replacing the bromide of silver by bichromated gelatine. But here also the colouration is seen only by reflected light. The theory of Wiener as to the production of

coloured images with silver compounds does not hold good in regard to these coloured images in bichromated gelatine because in this latter there are no silver layers, and Wiener's theory is based on the fact that the super-imposed and reflecting layers of silver in the film are the cause of the colours. One must thus conclude that the colours are caused by reflection from fine films of unchanged gelatine.

The basis of the various indirect processes of colour photography is the production of three negatives by means of three different light filters—three plates sensitive to red, yellow, and blue. With these three negatives polychrome prints can be made in various ways.

De Rausonet proposed to make three negatives by means of yellow, blue, and red filters, from these three lithographic stones, and to afterwards print in the appropriate colours by lithography. But this process did not give good results, for, though the negatives were taken through coloured screens, the plates were not specially sensitive to the different colours. Dr. Hauron's process suffered from the same defect. He printed from his negatives in carbon, and transferred to plates of mica.

When Vogel invented colour-sensitive plates, Drs. Albert and Obernetter were the first to succeed with tricolour reproduction.

But there are still many difficulties to be overcome. The problem of the selection of the proper blue, yellow, and red colours is one; these three colours must be such as shall give every other colour by admixture, a condition which at present cannot be fulfilled. As a matter of fact, the same three colours should be used both for sensitising and printing, a very practical difficulty, for most sensitisers are useless for printing purposes. Hence recource must be had to those colours which lend themselves to the printer's art, and hence, although extremely beautiful reproductions are made, fac-simile representations of the originals are, at present, not possible. Still, there is no occasion to despair. Wonderful progress has already been made, thanks to the researches of, amongst others, Dr. Vogel, Baron Hübl, Frisch, Husnik, and Angerer. Before leaving photo-mechanical colour processes, mention must be made of the synchromotypes of Turati, which are obtained by means of a press constructed by Turati himself, and with which only a single impression is required to give all the colours.

Amongst non-photo-mechanical processes, that of Ives led the way in viewing three images at one time. His apparatus simply consists of a lens through which the rays of light fall on one plate directly, and on two others by reflection. Each plate is provided with a suitable screen, and the positives thus printed from the negatives thus obtained are viewed against the glasses corresponding to the taking screens.

Vidal projects the three positives on to a screen. Nachet adopts Ives's arrangements, using stereoscopic apparatus. Selle makes three positives on collodion films, which he dyes red, blue, and yellow respectively. They are then super-imposed and projected.

Joly uses the idea of McDonough, taking a single view through a ruled screen of coloured bands, red, green, and blue, repeated across the plate. The result is a negative of very fine lines. A positive is made from this and placed in contact with a screen similar to that used in the camera, line to line.

Stockert's process possesses much of interest. From each of the negatives made, as for the tricolour process, a print is taken in gum-bichromate, the first for the yellow, the second for the red, and the third for blue. The three prints are made on the same paper, one on top of the others, sensitising twice more after the first printing.

Lumière similarly uses carbon. Hofmann has a similar process, in which the preparation of the negatives and registration of the prints is assisted by ingeniously devised apparatus.

General Notes.

Geography of Tea.—Mr. John McEwan, of 10 and 11, Lime-street, E.C., writes to ask that it may be mentioned that the paper on "The Geography of Tea," from which extracts, taken from *The Tropical Agriculturist*, appeared in the *Journal* of the 13th of July (p. 668), was written by him for the International Geographical Congress, held at Berlin in 1899.

The Guildhall Library. — The Guildhall librarian (Mr. C. Welch), in presenting the report to the library committee of the Corporation on the subject of the library and museum, states that the ordinary additions to the former during the year were 265 volumes of manuscripts, 2,131 volumes of printed books, 534 pamphlets, and 156 prints and maps. Of these 976 were purchases, 339 continuations, and 1,771 donations, and they included 426 volumes and two prints forming part of the Willshire bequest, Reference is also made to the collection of works by, and relating to, Sir Thomas More, which the late Mr. A. Cock, Q.C., bequeathed to the Corporation, and to the valuable library of Cruikshankiana acquired by the late Mr. W. Hamilton, together with his collection of dramatic literature, including a large series of theatrical portraits and play bills. Among the acquisitions to the museum have been many Roman and Saxon cinerary urns; specimens of Roman and medieval glass, and a holy water stoup from the foundations of the now demolished church of St. Michael Bassishaw, The cost of the library and museum for maintenance last year was £6,819, of which sum £3,325 was expended in salaries and wages. The total attendances of the public during the past year 337,268, as compared with 271,390 in the previous year, the daily average attendance being 1,208 in 1899 and 1,131 in the previous year.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Proceedings of the Society.

CANTOR LECTURES.

THE NATURE AND YIELD OF METALLIFEROUS DEPOSITS.

By Bennett H. Brough.

Lecture IV.—Delivered February 12, 1900.

Copper.

The metal, to which I wish to direct your attention this evening, was probably the first metal employed by man. The age of Copper followed the age of Stone. The oldest metallic objects to which a probable date can be assigned are a copper button, a bead and some wire from the tomb of the reputed first King of Egypt, B.C. 4400. At Tel-el-Sifr in Southern Chaldæa, traces of a large copper foundry dating back to B.C. 1500 have been discovered, whilst analyses made by Dr. Percy and by Sir William Roberts-Austen have shown that in the Mycenæan age, the period described in the poems of Homer and Hesiod, copper, unalloyed with tin, was largely employed. The metal was early obtained from the island of Cyprus, and was in consequence known as *aes Cyprium* or *cuprum*. In Germany, copper mining at the Rammelsberg began A.D. 968, and in the Mansfeld district in 1199. In Great Britain copper was obtained by the Romans in Anglesea; but in the Middle Ages little copper mining seems to have been carried on in England. In 1694, Swedish copper was used for the British coinage; and up to the middle of the 16th century, the Cornish copper ores were thrown aside as worthless. In 1564, however, Queen Elizabeth granted a mining concession to Thomas Thurland, of the Savoy, and Daniel Hochstetter, a German, who formed the company of the Mines Royal, details of which are given in Sir John Pettus' *Fodinæ Regales* (1670). This company started copper mines at Coniston near Keswick, at St. Just in Cornwall and elsewhere, together with the first copper works in Wales at Neath. In all these cases German workmen were largely employed. German miners were also brought over by Prince Rupert to work the now exhausted copper mine of Ecton in North Staffordshire. Traces of their work are still to be seen in the so-called Dutchmen's Adit. From this time onwards rapid progress in copper mining was made, and for more than a century Great Britain occupied the position of the chief producer of copper in the world. Some of the Cornish copper mines were remarkably rich, Tresavean, for example, in ten years (1828-38) yielded ore worth £770,338, half of which was profit. Devon Great Consols in 1845-65 realised £2,529,659, of which £991,930 was profit. The company working the Devon Great Consols mines started in 1844 to develop some old abandoned workings. A discovery of copper ore was quickly made, and during the first year's working over £70,000 profit was obtained. Up to April 30, 1899, the copper ore sold by the company realised £3,468,122, and the dividends paid have amounted to £1,223,878. The vein extends for nearly two miles, and 18 shafts have been sunk and 45 miles of levels driven. Arsenic is now the chief product of the mines. In other districts the mines of Alderley Edge in Cheshire, the Parys and Mona mines in Anglesea, the Knockmahon mines in county Waterford, and the Berehaven mines in county Cork were among the most profitable mines of the century. The rapid decadence of this great British industry is due partly to the fact that in Cornwall the copper ores have given place to tin in depth, and partly to the fact that the great depths attained and the large quantities of water encountered render competition with the vast American and Spanish deposits impossible. There are, however, large areas of mineral ground unexplored, and many old mines worth reopening, should the price of copper rise sufficiently, or should some of the disadvantages experienced by our mines make themselves felt abroad. Indications are not wanting that a further rise in price is possible. Owing chiefly to the rapid extension of the applications of electricity in all branches of industry, there has been in recent years a steady increase in the market value of copper, from £39 per ton in 1893 to £70 to-day. An impetus has consequently

been given to this important branch of mining, and it appears that the time is opportune for attempting to collect together details of the more important copper ore deposits now being worked, and for ascertaining their relative importance as sources of supply.

According to the statistics collected by Henry R. Merton and Co., the production of copper from the world's copper mines in 1898 was as follows:—

	Tons.	Per cent.
United States	234,271	55·1
Spain and Portugal	53,225	12·6
Japan	25,175	5·9
Chili	24,850	5·8
Germany	20,085	4·9
Australasia	18,000	4·2
Mexico	10,435	2·5
Canada	8,040	1·9
Cape Colony	7,060	1·6
Russia	6,000	1·4
Norway	3,615	0·9
Italy	3,435	0·8
Peru	3,040	0·7
Newfoundland	2,100	0·5
Bolivia	2,050	0·5
Austria	1,110	0·2
United Kingdom	550	
Sweden	480	
Hungary	430	0·5
Argentina	125	
Algeria	50	
Total	424,126	100·0

The percentage shares taken by the various countries in the world's production, calculated from Merton's statistics, will, I think, serve to indicate their relative importance as copper producers at the present time. Let us now consider the principal sources of supply.

United States.

In the production of copper the first place is taken by the United States, the chief deposits occurring in Montana, Arizona, and Michigan. The most productive copper ore mine in the world at the present time is the Anaconda mine, in the mining district of Butte, Montana, a region that since 1883 has surprised the world by the enormous quantities of copper ore that it has put upon the market. Here the ores occur in a series of strong fissure veins, averaging 10 feet in width, in granite. A later eruption of rhyolite cutting through the granite is thought by Mr. S. F. Emmons to have some relation to the ore-deposition. The ores near the surface consisted mainly of silver ores, lower down of oxidised copper ores, and in the still deeper portions of unaltered sulphides. In 1898 the Anaconda mine produced 48,500 tons of copper, more than 11 per cent. of the world's output, and the other mines in Montana produced 48,366 tons.

Next to Montana, as a source of copper supply, comes Arizona, whose mines in 1898 furnished 49,000 tons of copper. The deposits consist of masses of oxidised ores, mainly in Lower Carboniferous limestone. Masses of sulphide ore are found occasionally, indicating that in depth the oxidised ore will probably be completely replaced by sulphides. The chief producers in Arizona at the present time are the Copper Queen, the United Verde, and the Arizona Copper Company's mines.

The mining region of Lake Superior, which is one of the most interesting copper districts in the world, lies on a long peninsula projecting into Lake Superior, and terminating in Keweenaw Point, the copper belt being 130 miles long and 6 miles wide. The copper occurs almost exclusively in the native state, either in beds of conglomerate and sandstone, or of amygdaloid, or in veins in old crystalline rocks. The greater portion of the Lake Superior copper is obtained from the conglomerate beds. The Calumet and Hecla deposit, which alone furnished 41,000 tons of copper in 1898, more than one-tenth of the world's output, and up to the end of 1898 has paid over £11,000,000 in dividends, is an example of this class, as also are the Tamarack, Peninsula, and Allouez deposits. The cupriferous amygdaloids are portions of old lava flows. While the Calumet and Hecla conglomerate has been the most productive, the most striking instance of economical mining is afforded by a mine belonging to the Atlantic Mining Company, working on a softer amygdaloid bed of great uniform width, with very uniform, though exceedingly low, yield in copper. The accounts of that company show that the returns of copper to the ton of rock for a number of years is only 14 lbs., or 0·7 per cent.; while the cost of mining, raising it from a depth of 1,900 feet, and putting it on the market as refined ingot, averages 5s. per ton of rock mined. Other important mines working amygdaloid beds are the Copper Falls, Franklin, Huron, Kearsage, Osceola, and Quincy.

The veins, which at first were the exclusive source of copper in the district, have now taken a subordinate position. The copper occurs in the metallic state, usually in masses of great

size, the largest found weighing 600 tons. The first mine opened was the Cliff, which in 1884 extracted 12 tons of copper from a vein.

From the fact that the copper is generally found under heavy lava-flows, and associated with minerals produced from the decomposition of lavas, it appears probable that the copper was once finely disseminated through the lavas, and has since been concentrated by waters percolating through them. This view is advocated by Bauerman and by Wadsworth, while a similar view has been advanced by Emmons to account for the origin of the Leadville ore deposits. The Lake Superior copper deposits are remarkable for the absence of other metallic minerals except silver. The metallic condition to which the copper in the ore has been reduced so facilitates its extraction that a simple concentration and a single fusion in a reverberatory furnace suffices to convert it into metal of the very best quality. Consequently, there has been, as Mr. James Douglas* has shown us, little room for radical changes in treatment. There has, however, been a wonderful development in the mechanical appliances used. The old wooden stamps pounding a ton a day have given place to the steam stamphead of to-day pounding 250 tons a day. As even Calumet and Hecla ore yields only 3 per cent. of copper, the necessity for automatically handling vast quantities of ore is obvious. The Lake Superior region has been the scene of some marvellous achievements in mining. The Tamarack Company began by sinking a shaft to reach the copper-bearing bed, which dips at an angle of 38°, at a depth of 2,270 feet, and subsequently the Calumet and Hecla Company opened up their ground at a still greater depth and are now raising ore from their Red Jacket shaft, the deepest in the world, 4,900 feet vertically. This shaft has a daily output of 5,000 tons of ore. It has two 2,000 horse-power winding engines and a 7,000 horse-power ventilating plant. Careful experiments made in this shaft show that the temperature increases 1° F. for every 223·7 feet sunk. The value of these observations in relation to the possibility of mining at great depths I have already dealt with in a paper read before this Society.† It is interesting to note that the accounts of the Tamarack mine, where ore is being raised from a depth of 4,526 feet from the surface, show that the effect of increasing depth has been counter-balanced by that of increased output and of improved machinery. The very powerful winding engines that have just been erected at the Tamarack mine are a striking example of the manner in which the company spares no expense to obtain machinery of the best kind. The engine is of the diagonal type, and has four cylinders, each 36 inches in diameter by 60 inches stroke, connected two and two on to two crank-pins. The main bearings are 24 inches in diameter by 42 inches long, and the drum is 25 feet in diameter and 24 feet 6 inches long, and is provided with spiral grooves for 1½ inch rope. These spirals are, however, only provided at the ends of the drum, since the depth of the shaft being 6,000 feet, a drum of an enormous size would have been needed to carry out the principle of the spiral drum in its entirety, and hence the middle portion of the drum is cylindrical. The total weight of the drum and shaft is 300,000 lbs. The load to be raised consists of 6,000 feet of 1½ inch rope, weighing 21,800 lbs., the cage weighing 4,200 lbs., two waggons 4,000 lbs., and the rock mined 12,000 lbs., making a total of 42,000 lbs. suspended on one rope. Part of this, however, is balanced by the descending cage. The speed of winding is 4,000 feet per minute.

As an illustration of the scale on which mining is carried on in the Lake Superior district, I may mention that the Calumet and Hecla Company employs 5,100 men, and earns a profit of nearly £200,000 monthly. It has at work machinery with an aggregate horse-power of 50,000, and consumes 1,000 tons of coal daily.

Spain.

Next in importance to the American copper mines come those of the south of Spain. The numerous pyrites deposits in the province of Huelva, between Cadiz and the Portuguese frontier, are all contained in a belt of country running east and west, 80 miles long and 12 miles wide. The western end of this belt passes a few miles into Portuguese territory, where the San Domingos mine is situated, the other mines, Rio Tinto, Tharsis, and Aguas Tenidas being in Spanish territory. The district is composed of slates, in which Silurian and Lower Carboniferous fossils have been found. No Devonian fossils have been found, but it is possible, according to the views of Klockmann and Vogt, that there is a continuous series of Silurian, Devonian, and Lower Carboniferous strata. The slates have in many cases been altered into jasper, talc

* *Journal of the Society of Arts*, vol. xlvi., 1898, p. 28.

† *Ibid*, vol. xlv., 1897, p. 68.

schist, &c., by intrusion of eruptive rocks, quartz-porphyries and diabase-porphyries. The ore deposits are all lenticular in shape, often with an enormous width (sometimes as much as 500 feet). They are conformable with the surrounding slates and porphyries, and present a striking resemblance to the deposits of the Rammelsberg in the Harz, of Schmöllnitz in Hungary, of Sulitelma in Norway, of Mount Lyell in Tasmania, and of Ducktown in Tennessee, the geology of which has long been a matter of keen controversy. Gonzalo y Tarin, and other Spanish geologists, Professors de Launay, of Paris, and Vogt, of Christiania, and Mr. J. H. Collins, who, during his connection with the Rio Tinto Company, had exceptional opportunities of thoroughly investigating the geology of the region, consider that the three processes of the faulting of the strata, the eruption of porphyries and the deposition of the ores are intimately connected; in other words, that the deposits occupy cavities formed by fissures. On the other hand, F. Roemer and Klockmann consider the deposits to be of sedimentary origin.

The manner in which the Huelva deposits are characterised by a very irregular lenticular shape is shown by the following approximate dimensions of the principal ore bodies:—

	Length.	Maximum thickness	Mean thickness at surface.	Pyrites area at surface.	Deepest shaft.
Rio Tinto:—	yds.	yds.	yds.	sq. yds.	feet.
Dionisio Lode	1,000	150	65	70,000	1,225
South Lode ...	1,100	180	50	50,000	1,000
North Lode ...	300	100	80	25,000	500
Aguas Tenidas	150	75	50	7,000	500
San Domingos.	400	75	40	15,000	500

The figures are the estimates of Professor Vogt, the most recent investigator of this region, who is my authority for most of the particulars submitted.

The deposits wedge out at a comparatively slight depth, with the exception of the Dionisio Lode at Rio Tinto, the largest mass of pyrites in the world, which has been followed to a depth of 400 yards, and has been found to exhibit a remarkable swelling out. Including the Tharsis deposits, which, with those worked out, cover an area of 100,000 square yards, and the smaller deposits, the total pyrites area of the Huelva mines amounts to 500,000 square yards. The amount of ore still available is estimated at 135,000,000 tons, which at the present rate of production will last for about 50 years. According to calculations by Mr. W. G. Bowie, in the *Mining Journal*, from the beginning of modern working in 1850 to 1894, 58,000,000 tons of ore have been extracted from the Huelva mines. Thus up to the end of 1899 the output has amounted to about 73,000,000 tons, and in the time of the Romans the total output was probably not less than 30,000,000 tons. The ore contains on an average 2·9 per cent. of copper. Throughout the Huelva copper district it is found that the percentage of copper in the pyrites decreases with increasing depth. In the Dionisio Lode at Rio Tinto, for example, the average proportion to a depth of 150 yards was 4 per cent.; at 200 yards it was 2 per cent.; and at 350 yards it was 1·25 per cent.

The Huelva mines were worked in very ancient times. Spanish archæologists have found remains of Phœnician workings dating back to the 11th century B.C. It was, however, in Roman times that working was prosecuted on an enormous scale for about eight centuries. The deposit was mined in all directions by a network of narrow shafts and levels laboriously carved out with hammer and chisel to a depth of 100 yards. The Roman levels in Rio Tinto alone had a total length of 180 miles, the whole being the work of slaves and convicts. At that time the production of metallic copper was some 2,000 tons annually. Remarkable instances of the preservative qualities of solutions of copper salts can be seen in the old workings at Rio Tinto. The timbers have been so preserved as to retain markings and inscriptions cut by Roman miners 18 centuries ago. A Roman mine door from Rio Tinto, in excellent preservation, was shown at the Barcelona Exhibition in 1888.* In the 8th century mining ceased, and the mines were idle during the whole of the Moorish period, little being done until the middle of the present century. In 1850 the Spanish Government began mining on a fairly extensive scale at Rio Tinto. The San Domingos mine in Portugal was re-opened in 1858, and the Tharsis mines in 1860 passed into the hands of a joint stock company. In 1872 the Rio Tinto mine was sold by the Spanish Government to an English company at a price of 92,800,000 pesetas or, at the rate of exchange then obtaining, £3,625,000. At the present time Rio Tinto produces 1,388,000 tons of pyrites, Tharsis 600,000

* "Barcelona Exhibition." By B. H. Brough. *Journal of the Society of Arts*, vol. xxxvi., 1888, p. 1,159.

tons, San Domingos 200,000 tons, and Aguas Tenidas 200,000 tons of pyrites (with 50 per cent. of sulphur, but no copper). Altogether the Huelva mines afford employment to 25,000 men. The mines are worked open-cast to a depth of 100 yards, and at greater depths by underground mining. In 1898, there were obtained from Rio Tinto, 33,705 tons of copper; from Tharsis, 12,000 tons; from San Domingos, 3,600 tons; and from other mines in the district, 3,920 tons. The production of copper from Huelva ores appears to have attained its maximum. It now represents 13 per cent. of the world's output, whereas in 1180 it represented $23\frac{1}{2}$ per cent. Owing to the narrowing of the deposits, to the decrease in the percentage of copper, and to the increase in the cost of mining with increasing depth, the present enormous rate of production cannot probably be maintained for more than twenty years. In the case of Rio Tinto, which possess exceptional reserves of ore, the conditions are more favourable than in the other Huelva mines; but although there is an ore supply for fifty years, it is not probable that any considerable increase in the production of copper will be effected.

Japan.

In Japan, were the production of copper in 1898 was 25,175 tons, remarkable instances are furnished of the longevity of copper mines. Mines started in the 9th century are still being profitably worked. Moreover, recent vertical shafts sunk to a depth of 1,000 feet are stated to have revealed early workings extending even below that depth. From these great depths the ore was carried to the surface in baskets on men's backs through galleries connected by short ladders. The principal mines are at Ashio where veins of sulphide ore occur in rhyolite, and at Besshi where a low-grade vein of copper pyrites is worked.

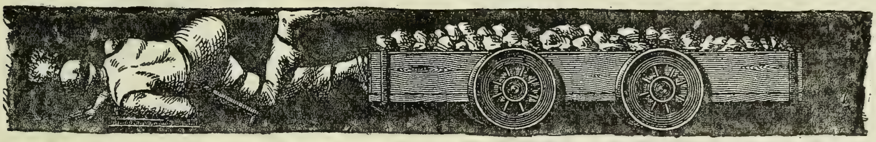
South America.

In Chili copper is the most important product of the country. The ores are obtained chiefly from veins and the production of copper in 1898 was 24,850 tons. Copper ore is one of the most valuable products of Bolivia, the production of copper in 1898 having been 2,050 tons. The principal mine is that of Corocoro. Some 3,040 tons of copper were also derived from Peru.

Germany.

In Germany, the southern and eastern flanks of the Harz have acquired a world-wide interest from the seam of copper shale of the Mansfeld basin, in which mining has been extensively carried on since the year 1199. About 1483, when Martin Luther's father was working here as a miner in humble circumstances, 1,000 tons of copper were annually produced. In 1852, the independent companies that had been carrying on operations continuously since 1573, were consolidated into one great corporation, which now produces annually some 15,000 tons of copper, and 75 tons of silver, and affords employment to 13,000 miners. Mansfeld was the first place in Germany where steam-power was employed for mining purposes, a "fire-engine," made by James Watt, having been imported in 1785 from England, for pumping the mines. The ore is a bituminous shale bed of Permian age, with a thickness of 15 to 18 inches, containing disseminated particles of copper ores. The seam is much faulted in places, and in the fissures thus formed veins of silver, copper, cobalt, and nickel ores are found, derived evidently from the solution of minerals in the seam. The Permian strata form a fairly regular basin, covering 193 square miles, round the edge of which the copper shale crops out. The workings are chiefly confined to the northern and western sides of the basin, where the copper shale occurs nearly horizontally for a length of 14 miles. The whole of the bed contains copper, but, as a rule, only the bottom $2\frac{1}{2}$ to 5 inches are rich enough to be profitably worked. Owing to this restricted height it is necessary to remove a sufficient portion of the roof to enable the miner to work. As he reclines on his side the breadth of the shoulders is the minimum height possible, and the seam is often worked with a height of 16 inches only. For removing the ore, specially designed trucks are necessary (Fig. 24), and these are

Fig. 24.



dragged by lads moving in a snake-like manner from the working places to the main roads, where the contents are transferred to ordinary mine waggons. The copper shale contains on an average 2 to 3 per cent. of copper and 163 ounces of silver to the ton of copper. In 1898 the Mansfeld Company raised 641,004 tons of ore, which yielded 2·95 per cent. of copper and 0·018 per cent. of silver.

Of late years a serious obstacle to the development of the mines has been caused by water percolating into the mines from a lake covering a considerable area of the copper district. In 1884 there was a serious irruption of water, and a still more serious one in 1889, when the water rose 120 yards in the workings. Pumping was carried on with but little effect, and in 1892 the level of the Oberröbling Lake at the surface began to sink, showing that there was some connection with the mines. The company then conceived the heroic plan of pumping the lake dry. Powerful centrifugal pumps were installed, capable of raising 4,238 cubic feet of water per minute to a height of 12 yards. Canals were constructed to carry off the water. By degrees the mines were freed from water, and at the same time the bottom of the lake was rendered available for agricultural purposes.

Another German copper ore deposit of special interest is that of the Rammelsberg, near Goslar in the Harz. It is remarkable on account of its great antiquity, the mine having been worked ever since 972 A.D., and also on account of the controversy as to the manner of its formation which long obtained between the adherents of the sedimentary theory and those of the eruptive theory. The former—including von Groddeck, Stelzner, Wimmer, Koehler, and many other leading German geologists—consider the deposit to be a bed perfectly conformable with the surrounding strata, whilst the Norwegian geologist, Vogt, adduces evidence to show that it is a bedded vein formed subsequently to the enclosing strata, its formation being due to the outbursts of eruptive rocks in the vicinity. The same mode of formation is thought to have obtained in the case of the analogous deposit at Rio Tinto. The Rammelsberg deposit occurs in contorted and faulted strata of Devonian age. (Fig. 25.) The length opened up by mining operations is 1,300 yards, the depth 380 yards, and the maximum normal thickness 12 to 15 yards, the surface area of the ore deposit being 8,000 square yards. The ore consists of a hard dense mixture of galena with zinc blende, iron pyrites, and copper pyrites. Up to the year 1870 the ancient method of fire setting was used for breaking down the ore. Progress in the use of explosives for blasting led to the abandonment of that method, and the work is now carried out

FIG. 25.

by the aid of compressed-air rock-drills and gelatine-dynamite. The cost of mining a ton of ore by hand boring is 4s. 6d., and by rock-drills 3s. The ore sent to the smelter is divided into five classes, the percentage composition of which is as follows:—

	Copper.	Lead.	Zinc.	Iron.
Copper ore I. . .	17·66	3·70	9·55	23·02
Copper ore II.	9·64	2·41	5·82	30·37
Copper ore III.	4·68	1·77	4·89	33·52
Mixed ore	4·52	9·98	21·45	12·41
Pyritic ore	1·01	6·65	15·43	24·51

All the ores contain gold (0·00006 to 0·00016 per cent.) and silver (0·008 to 0·017 per cent.), and intermixed barytes and slate. The output in 1898 was 55,000 tons, 400 men being employed.

SWEDEN.

Leaving for a moment the order of relative importance of the copper-producing countries,

I must ask you to turn your attention to a remarkable deposit presenting many points of similarity to the Rammelsberg. In former days a veritable treasure house of copper, the mine at Falun, the most ancient and most extensive in Sweden, is of the greatest historical interest. It is owned by the Stora Kopparberg Mining Company, the oldest joint-stock company in the world, the foundation of its business dating back to the 13th century. Although the date of the actual beginning is not known, a Royal Charter of the year 1347 confirming the then ancient privileges is preserved, and a still more ancient deed relating to the transfer of shares, by Bishop Peter Elofsson in 1288, may be seen in the National Archives at Stockholm. The original business of the company—copper mining—is now completely subordinate to the other branches—iron and steel manufacture, and wood-sawing.

The Falun deposit, which has been worked for nearly 700 years, originally as an open quarry, is, as I pointed out in a previous paper,* in many respects similar to the Rio Tinto deposit. It is an irregular mass of cupreous iron pyrites, about 650 feet long and 500 feet broad at the surface. It diminishes and appears to wedge out in depth. The ore contains on an average 2 to 5 per cent. of copper. It also contains an appreciable quantity of gold, the present yield being about 2,000 ozs. annually. The production of copper ore in 1898 was 15,918 tons. Up to the beginning of the 18th century mining was carried on by fire-setting, and the annual consumption of wood for this purpose rose to more than 2,000,000 cubic feet. Several times the masses of timbering caught fire, and the mine caved in. Such disasters occurred in 1687, 1833, and 1876; the most serious was that of 1687, which formed a huge chasm 1,180 feet long, 600 feet broad, and 285 feet deep. Improved methods of working to obviate the recurrence of such catastrophes were introduced in 1877. Accurate statistics of production have been kept since a very remote period. These show that the total output of the mine from the earliest times to the present day represents a value of more than £5,550,000 sterling. In order to obtain this, some 35,000,000 tons of ore have been raised, and the metal obtained is the equivalent of a cube of copper 126 feet in the side, or a cylinder 50 feet in diameter and 1,000 feet high.

* *Journal of the Society of Arts*, vol. xlvi., 1898, p. 65.

The greatest production was obtained in 1651, when the amount of metallic copper made was 3,066 tons, and the lowest in 1833, when the production was 338 tons. At the present time the copper is usually sold in the form of copper vitriol, of which 1,164 tons were made in 1898. Besides this, the works produced 109 tons of sulphate of iron, 2,000 tons of sulphuric acid, 1,000 tons of red ochre, 212 kgs. of silver, and 110 kgs. of gold.

The red ochre referred to is obtained by calcining the products of the weathering of the iron pyrites. It is used throughout Sweden for painting the farmhouses, cottages, and mine buildings, and is so general that it forms a characteristic feature of Swedish scenery.

The mine at Falun is 1,200 feet deep, and its underground roadways have a total length of about 18 miles. There is abundant evidence of the long continued activity, the greater part of the thousand acres of land belonging to the mines being covered with slag heaps, while the vegetation has been destroyed by the sulphurous fumes of the roasting heaps.

At Falun the company possesses a museum of objects illustrating its history, prominent among them being a collection of the inventions of Christoffer Polhem, the engineer at the mines in the latter half of the 17th century, who introduced most of the mechanical appliances that have been in use in Swedish mines down to our own times. There are also many examples of the copper coinage issued during the 17th century, roughly squared pieces of hammered plate, stamped with the value in the centre, and the Royal cypher and date at each corner. The largest of these, a 10-dollar piece made in 1644, measures $22\frac{1}{4}$ by $12\frac{1}{2}$ inches, and weighs $43\frac{1}{2}$ lbs.

AUSTRALASIA.

It is to Australasia that we must look for the new sources of supply to meet the increasing scarcity of copper. Copper ores are widely distributed throughout the Australasian colonies. The development of the copper industry has, however, been retarded in the past by the distance of the mines from the port of shipment, and by the difficulties and cost of land transport. These drawbacks are now rapidly disappearing, and it may be confidently anticipated that rapid progress will soon be made. Thanks to the remarkable deposits at Mount Lyell, Tasmania now takes the first place in the production of copper, the relative values of the copper production of the colonies being as follows:—

Colony.	Production for 1897.	Total production to end of 1897.
	£	£
South Australia...	242,917	21,280,889
New South Wales..	283,174	4,351,343
Queensland........	12,645	2,020,761
Tasmania	323,650	491,876
Victoria	—	206,395
West Australia	1,033	167,849
New Zealand......	2	17,868
Total		28,536,981

The immense pyrites deposit at Mount Lyell, Tasmania, worked by the Mount Lyell Mining and Railway Company, was discovered in 1886, and was worked up to 1890 as a gold mine, the gold occurring in friable iron ore. It was then found that this was merely the product of the decomposition of a mass of cupriferous iron pyrites similar to that at Rio Tinto. The mass is at least 300 feet thick and 960 feet long, and composed of nearly pure pyrites lying in ribs parallel to the stratification of the enclosing rocks. The ore consists of 83 per cent. of iron pyrites and 14 per cent. of copper pyrites, its average contents being 4·5 per cent. of copper, 3 ounces of silver to the ton, and 2½ dwt. of gold to the ton. The freedom of the ore from silica is remarkable. No preliminary treatment is necessary, the ore is fed into the furnaces just as it comes from the mine, with the addition of 20 per cent. of quartz flux and 5 per cent. of fuel. During the year ending September 30th, 1899, this mine produced 250,416 tons of ore, yielding 3·3 per cent. of copper, 3·4 ounces of silver to the ton, and 0·1 ounce of gold to the ton.

The history of copper mining in South Australia dates from the year 1842. The Burra Burra mine, for many years the richest copper mine in the world, was worked from 1845 to 1877. After the investment of the working capital, £12,320, no calls were made, and £800,000 was paid in dividends. The Moonta and Waleroo mines were opened in 1861 and 1864, and proved the richest in the colony. They are now worked together. The Moonta veins vary from 3 feet to 8 feet in thickness, and those of Walleroo attain to 20 feet. The South Australian copper mines are energetically worked, for upon their yield the prosperity of the colony largely depends.

The copper-mining industry of New South Wales entered upon a new era of prosperity in 1894, when the Great Cobar mine was reopened. This mine, which is situated 450 miles west of Sydney, in 1898, raised 11,557 tons of ore, representing 3,520 tons of fine copper, the percentage yield being 3·24. The copper extracted has been found to contain gold more than sufficient to pay for mining and treating the ore. The gold contents of the copper produced during early operations varied from ½ oz. to 3 oz. per ton. The metal was sold for many years without the attention of buyers being drawn to the presence of silver and gold. When this was done in 1894, the immediate result was an advance of £7 per ton over the current quotations for Chili bars. The ore occurs in a vein, varying remarkably in width from a mere film up to 100 feet, traversing Silurian rocks. Near the surface, oxidised ores occur, but at a depth of 250 feet they are replaced by solid copper pyrites. The deepest shaft is 540 feet. At that depth the present working face is 70 feet wide in solid cupriferous iron pyrites. Compressed air rock-drills are employed, and the electric light has been installed above ground. The ore is smelted on the spot, the plant including four 80-ton water-jacketted blast furnaces with a working capacity of 120 tons per 24 hours. Two additional furnaces are in course of erection. A similar important deposit is that of Nymagee, in county Mouramba, where the vein occurs in rocks of Silurian age. At the lowest depth reached, 734 feet, the vein is 30 feet wide and composed of massive pyrites, containing 2 per cent. of copper. The ore raised in 1898 amounted to 17,152 tons, yielding 728 tons of copper, an average of 4½ per cent. In addition to these deposits there are many others widely distributed through New South Wales. The principal deposits occur in the central part of the colony, between the Macquarie, Bogan, and Darling rivers. Deposits have also been found in the New England and Southern districts, while the copper production of the Broken Hill silver mines is considerable. A detailed description of all the known copper deposits in the colony has been prepared by Mr. J. E. Carne for the New South Wales Department of Mines.

In Queensland, the principal copper deposits are veins worked at the Peak Downs, Cloncurry, and Chillagoe mines. In New Caledonia the copper region occupies both flanks of a mica-schist range, through which serpentine protrudes in places. The main deposit worked consists of several parallel masses of ore enveloped in foldings of the schist.

Other Countries.

In Mexico copper ore is raised in large quantities from tufaceous beds containing oxidised copper ores at the well-known Boleo mine, which is worked by a French company. Work was begun here in 1884, and in 1898 the output was 9,436 tons of copper.

Since 1852 rich copper ores have been obtained in large quantities from irregular beds, interstratified in gneiss, in Namaqualand, Cape Colony. The two companies now at work are the Cape Copper Mining Company, which in 1898 produced 4,660 tons of copper, and the Namaqua Mining Company, which produced 2,400 tons of copper.

Canada is also a copper-producing country. Cupriferous pyrites is mined at Capelton, Quebec; and a good deal of copper is obtained from the richest nickel mines in the world, at Sudbury, Ontario. In British Columbia the Le Roi, War Eagle, and Hall mines, in the Rossland district, are all very productive. The veins in Rossland are typical fissure veins, but without sharply defined walls. The Canadian production of copper in 1898 amounted to 8,040 tons.

In Newfoundland the Tilt Cove mine raises ore from lenticular masses of cupriferous iron pyrites in metamorphic rocks. These deposits, which are owned by the Cape Copper Company, are somewhat similar to those of Rio Tinto. The production of copper from Newfoundland in 1898 was 2,100 tons.

Turning again to Europe we find that the production of copper from the important masses of cupriferous iron pyrites in Norway amounted in 1898 to 3,615 tons.

Again, in Italy, the Monte Catini mine in Tuscany affords an excellent example of a contact deposit, being developed along the line of outcrop of certain gabbros. Worked by the Etruscans, the deposit has in the past produced large quantities of ore. The mine is still in operation, but the output is small, the total production of copper in Italy in 1898 having been 3,435 tons.

Future Sources of Copper Supply.

Such, then, are the world's chief sources of supply, from which in 1898 there was obtained 424,126 tons of copper. Twenty years ago the world's copper production was 153,959 tons, and ten years ago it was 261,205 tons. Assuming that in the next ten years the increase in consumption will be at the same rate, it may be estimated that in 1908 the amount of copper needed will be 700,000 tons! How can an increase of such magnitude be met? The Lake Superior mines have for some years past maintained a uniform level of production, as also have the mines of Austria, Bolivia, and Newfoundland. Montana, Spain, Germany, Mexico, Russia, and Italy have shown but a slight tendency to increase their output; whilst in Chili, the United Kingdom, Sweden, Hungary, Argentina, and Algeria the output is diminishing. The only States that have of recent years shown a considerably increased copper production are Arizona, Japan, Australasia, Cape Colony, and Peru. It is to these countries that we must look for new sources of supply, such as the Mount Lyell mines in Tasmania, which in a few years time will probably increase their output very largely. At the same time the advisability of opening up the poorer copper ore deposits must not be lost sight of. American consumption is now increasing more rapidly than the supplies there, and in order to prevent further dwindling of the meagre stocks, we must depend on the growth of production elsewhere. Undoubtedly, therefore, it would be of great national advantage if some of the many old copper mines in this country, now lying idle, could be reopened. This should be possible if the present price of copper be maintained. Looking back on past history we see that the present price is not unheard of. For more than 100 years, before 1875, it was considerably higher than it now is. From 1811 to 1820 it averaged £130 per ton, and from 1851 to 1860 it averaged £111. It is the discovery of the rich deposits in Montana that has kept the price down for so long.

Lead.

According to the statistics collected by the Frankfort Metal Company, the world's production of lead in 1898 was as follows:—

	Tons.	Per cent.
United States	196,900	25·0
Spain	179,000	23·0
Germany	132,700	17·1
Mexico	71,000	9·2
United Kingdom	49,000	6·3
Australasia	48,000	6·2
Italy	22,500	2·9
Greece	19,600	2·6
Canada	16,000	2·1
Belgium	14,700	1·9
Austria	10,000	1·3
France	10,000	1·3
Hungary	2,000	0·3
South America	1,200	0·2
Other countries	4,500	0·6
Total	777,100	100·0

The price of lead during this century has fluctuated in a remarkable manner, and with the fall in price Great Britain has been unable to maintain its position as chief producer in the world, and is now surpassed by the United States, Spain, Germany, and Mexico. Scattered throughout the kingdom there are, however, numerous rich lead mines that have produced in the past, and can produce in the future, vast quantities of ore. In limestone there are the deposits of the northern district (Alston Moor, Weardale and Teesdale) of Derbyshire, and of Flintshire and Denbighshire (such as Minera, one of the most productive mines in the world). In slate, there are the lead veins of the Isle of Man (Foxdale and Laxey mines, both rich in silver), of the Lake District, of Shropshire (Snailbeach, Tankerville and the Roman Gravels), of Cardiganshire and Montgomeryshire, of Devon and Cornwall, of Lanarkshire (Leadhills), and of Dumfrieshire (Queensberry mines, Wanlock Head).

Time will not permit me to describe the principal lead deposits of the world. Suffice it to say that we have illustrations of the occurrence of lead ore in veins, in beds, and in masses. Typical examples of the first-class of deposit are afforded by the lead veins at the following localities :—Linares, in Spain; Clausthal, in Germany; Monte Vecchio, in Sardinia; Bleyberg, in Belgium; Przibram, in Bohemia; Pontgibaud, in France; Sentein, in the Pyrenees; the Slocan, in British Columbia; and Zeehan, in Tasmania. The lead production of Australia is derived chiefly from the Broken Hill silver mines in New South Wales.

The mines of Clausthal in the Upper Hartz, which have been worked for nine hundred years, are of great interest historically, geologically, and technically. The veins contain argentiferous galena with zinc-blende, copper and iron pyrites, quartz, calcspar and spathic iron ore. The Clausthal veins which traverse Lower Carboniferous rocks, sometimes reach a thickness of 130 feet. The foot wall is sharply defined, but the hanging wall is usually shattered and passes into a breccia containing fragments of the enclosing rocks. The mines are worked by the Prussian Government, and have reached a depth of 2,400 feet. There is a very extensive series of works for concentrating the ores to which the output of the various mines is brought. A subterranean canal, communicating with the Ottiliae main winding shaft at the concentrating works, connects the workings and serves both for the transport of the ore in barges and for draining the mines. For technical reasons this curious method has now to be given up, and the ore carried at a level 750 feet deeper. Electric haulage will be used, and the main shaft is being continued down to the required depth.

Of the occurrence of lead ore in beds, the most striking example is afforded by the lead-bearing sandstone of Mechernich in Rhenish Prussia, a bed 100 feet in thickness containing 2½ per cent. of lead in the form of small concretions of galena; whilst examples of the occurrence of lead ore in masses in limestone are afforded by the marvellous deposits at Leadville in the Rocky Mountains, at Laurium in Greece, at Raibl in Carinthia, in the Coeur d' Alêne district of Idaho, and in Missouri and other parts of the United States.

OTHER METALS.

The world's production of crude zinc in 1898 was as follows :—

	Tons.		Per cent.
Germany	153,000	..	32·7
Belgium	132,000	..	28·3
United States ..	105,000	..	22·2
United Kingdom	28,000	..	6·0
France	27,000	..	5·8
Austria-Hungary	7,000	..	1·5
Spain	6,000	..	1·3
Russia	6,000	..	1·3
Other countries..	4,000	..	0·9
Total ..	468,000	..	100·0

In the United Kingdom the largest zinc ore mine is Minera, near Wrexham, where veins containing zinc blende and galena occur in Carboniferous limestone. In Germany zinc ore is obtained from veins near Cologne; but the greater portion of the German supplies are obtained from irregular masses in limestone in Silesia. The Belgium supplies are obtained from similar deposits. At Åmmaberg in Sweden, zinc blende occurs in beds. In the United States the most important zinc-producing region is the Joplin district in Missouri, and Kansas. In Missouri, during the year ending June 30, 1899, there were 1,001 shafts in operation, which raised 181,430 tons of zinc ore and 70,829 tons of lead ore.

In the case of tin, Professor Henry Louis estimates that the world's production in 1898 was as follows :—

	Tons.		Per cent.
Straits Settlements	47,400	..	61·5
Dutch East Indies	14,270	..	18·2
Australasia	5,500	..	7·0
Cornwall	5,460	..	6·9
Bolivia	4,500	..	5·7
Other countries ..	200	..	0·7
	77,330	..	100·0

The Cornish tin deposits have recently been fully described by Mr. J. H. Collins,* and the foreign sources of supply have been so exhaustively dealt with by Professor Louis, that it is unnecessary for me to refer to them. The world's nickel ore deposits, too, have already been described in detail in the *Journal* of the Society, by Mr. A. G. Charleton.†

The world's production of quicksilver, or mercury, in 1898, was as follows:—

	Tons.		Per cent.
Spain	1,681	..	41·0
United States	1,076	..	26·5
Russia	633	..	15·5
Austria-Hungary ..	500	..	12·3
Italy	192	..	4·7
Total	4,082	..	100·0

Of the production of mercury in Mexico and China trustworthy returns are not available. The bulk of the world's supply is obtained from the following mines: Almaden, in Spain, where cinnabar occurs, impregnating beds of Devonian sandstone; New Almaden, in California, where cinnabar occurs in veins in metamorphosed rocks of early Cretaceous or late Jurassic age; Ekaterinoslav, in Russia, where cinnabar is disseminated through a bed of sandstone; Idria, in Austria, where mercury has been obtained, since the year 1525, from cinnabar-bearing veins and masses in Triassic rocks; and Monte Amiata, in Tuscany, where cinnabar occurs in masses at the contact of trachyte and Eocene limestone. In China mercury is obtained in the province of Kwei-Chou.

Correspondence.

REPORT ON THE STATE OF AMAZONAS, BRAZIL, 1900.

Last year the British Consular agency in Brazil was strengthened by the appointment of a Vice-Consul at Manaos in the Amazonas. The first result of this arrangement is the presentation of a really capital report by the new Vice-Consul, Mr. Charles Lindsay Temple. This paper, which has been printed by the Foreign-office among its Consular Reports for 1900, is very interesting and instructive reading from a geographical point of view, with much graphic and descriptive merit also. It indicates the physical geography of this river-kingdom, which is the upper, or more properly speaking, the middle basin of the Amazon—the almost entire submergence of the area, when the mighty floods are out and the waters cover not so much the earth as the forest—the rapid subsidence of the all-pervading inundation, owing to the natural drainage and to the sun's rays.

One special feature is the preparation of caoutchouc or india-rubber, which is the main product of this forest-clad country. This article has always been largely used in Britain for waterproof clothing. But of late years the use for it has multiplied owing to the demand for the wheel-tyres of bicycles. Evidently the Vice-Consul has expert knowledge of all that relates to this valuable article, and this experience is embodied in the report with scientific accuracy and practical lucidity. Such an exposition must be important to those who are interested in this branch of trade.

Apart from this staple, there is a careful analysis of every item of export and import. Inasmuch as this vast territory of 600,000 square miles has its scanty population of 600,000 souls, largely engaged in producing certain things which the nations need across the seas, it follows that the people must largely depend on those nations for their food, their clothing, and the needs of their civilisation, though it must be admitted that this civilisation is for the most part not very high. Thus it arises that their trade is both comprehensive and diversified. The report enters into every item of export and import, with some adequate remark upon each. It refers not only to the trade, but to the traders also, and especially to the foreign traders—European in competition with the British. These passages are well worthy the consideration of British manufacturers. There seems to be no doubt that to some extent the superior, more solid, and necessarily high-priced goods of British manufacture are pushed out of use by the inferior, the less-enduring, and the cheaper goods of European nations. Perhaps this cannot be prevented. Perhaps also it ought not to be prevented, inasmuch as British manufacturers may not care to do this inferior business. Nevertheless the report explains that owing to climatic conditions of heat and damp, it is often not worth the while of people to get good things which will not last, and this too at a certain price—when they can get at a lower price, goods which however inferior will last long enough for their temporary purposes.

The report is not commercial only; it relates to the society, the various classes, and the civil government. It comprises a good description of Manaos, which is not only the capital but the only city of the country.

* *Journal of the Society of Arts*, vol. xlvii., 1899, p. 359.
† *Ibid*, vol. xlii., 1894, p. 496.

This place is no doubt an ornament in a remote region—full of tasteful buildings and manifold institutions. But this being mainly a commercial report, it is well supported by statistical tables supplying all the information that can possibly be had, indeed all that a trader could reasonably desire.

Information has been courteously supplied by the Amazonas State authorities at Manaos regarding many commercial affairs. Regarding internal economy the information is as yet less accurate because the country is itself but newly settled. A census will it is understood be taken by the end of 1900.

Some special facts or considerations may, however, here be noted. The dominant factor in the Amazonas trade is the indiarubber. Indeed, of the production of the world, 57,500 tons, about half, or 25,000 tons, comes from the Amazon district; of the other half, the greater portion, or 24,000 tons, comes from East and West Africa.

Manchester firms continue to supply the greater amount of the cotton goods; but the United States have entered the market with drills and sailcloth; and Germany is making great efforts, by means of travellers and long credits, to get a hold on the market. Germany, again, supplies tweeds and serges, British goods of that kind being too dear for that market. The labouring classes in this climate often go barefooted, so there is no demand for heavy boots, but there is for the medium kinds which are supplied by Britain, the lighter kinds coming from Austria. It is to be regretted that axes, knives, and cutlery come more from America and Germany than from Britain.

On the whole, British trade in this quarter is but stationary, while French is declining, but that of the United States and of Germany is growing.

The crying want will not be capital or communication—that by water being peculiarly abundant—but labour, which is, as yet, too scarce.

I may conclude by quoting from the report a remark which has been already made by our Consular Staff in other regions, but which cannot be repeated too often in the interests of British Commerce. It is said:—

"Another very good reason for the disappearance of many lines of British manufactures from the market is the lack of travellers representing British firms that visit the country. Too much attention cannot be paid to this point. The 'personal eduation' is an all important factor in business transactions in Brazil, and there is probably no better field for a man to show his capabilities. I believe that the mere distribution of catalogues and price lists, unless accompanied by travellers, even if written in Portuguese, is of but little value. They are more likely to suggest business to competing firms into whose hands they are bound to fall than to bring business to a firm that sends them. The only way to push business in Brazil is to have good travellers and good agents. German manufacturers are aware of this, and their travellers are very much more frequently to be met with than those of British firms."

RICHARD TEMPLE.

General Notes.

SHIPPING OF THE WORLD.—From the statistical tables compiled by Lloyd's Register, it appears that there are at present in existence 28,422 vessels, of 29,043,728 tons gross, of which 15,898, of 22,369,358 tons gross, are steamers, and 12,524, of 6,674,370 tons register, sailers—against 28,180 vessels, of 27,673,528 tons (15,324 of 20,877,746 steam, and 12,856 of 6,795,782 sail), a year ago. Of steamers, Great Britain and her Colonies own 7,930, of 12,149,090 tons gross, as compared with 7,837, of 11,717,247 tons a year ago; Germany 1,209, of 2,159,919 tons, against 1,133, of 1,946,732 tons; and France 662 vessels, of 1,052,193 tons, against 639, of 997,235 tons. In sailing ships the British total has decreased to 2,908 vessels, of 2,112,164 tons, from 3,161, of 2,269,261 tons a year ago, and the Norwegian to 1,574 vessels, of 876,129 tons, from 1,749, of 956,818 tons.

ELECTRICITY IN AGRICULTURE.—An association of farmers in Bavaria, according to a writer in "Feilden's Magazine," are building large electrical works to supply power for agricultural uses. The current is generated near the village of Schaftersheim, a distance of seven miles from the district of consumption, and is supplied partly by steam and partly by water power. From there it is to be sent at a pressure of 5,000 volts to the surrounding villages, where it will be employed for driving threshing machines, chaff cutters, bruising machines, &c. The motors used are very simple and compact, so that they can easily be handled by farm hands. If this experiment should prove successful, it is almost certain to be imitated in other portions of Germany, as the power used, according to the estimates, is far more economical than horse power or steam power in separate plants; and there might be a very profitable market for such installations also in our own country.

BERMUDA.—The report on Bermuda for the past year by Mr. Alison, the Colonial Secretary, shows a revenue of £39,955, with an expenditure of almost exactly the same amount. A material increase in the revenue over that of the preceding year is attributed to an increase in the Customs revenue under almost every heading, and this is due to the growing popularity of the islands as a winter resort, as well as to an increase in the troops. The total public debt at the end of the year was £44,800. The imports amounted to £394,388, of which about one-third came from Great Britain and Canada, and most of the remainder from the United States. The chief imports from Great Britain were cotton and woollen goods, liquors, and sugar, and from the United States foodstuffs. The exports amounted to £125,817, of which £111,638 worth went to the United States. Onions were exported to the value of more than half the total exports, potatoes and bulbs coming next in importance. Exports as well as imports appear to be increasing in value.

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SOCIETY OF ARTS MEDAL.

It was mentioned in the last Council Report that it has been found necessary to prepare a new die for the Society of Arts medal, a slight flaw having developed itself in the die which has been used for striking the medals since the year 1863, when H.R.H. the Prince of Wales became President.

The Council ascertained His Royal Highness's wishes as to the head which should appear on the medal, and he expressed a preference for a new head, which might be a likeness of himself at the present time. He also expressed a desire that the execution of the new die should be entrusted to Mr. Emil Fuchs, who had previously been very successful in the preparation of a medallion portrait of His Royal Highness.

An illustration is now given of the die which Mr. Fuchs has prepared, and it will be generally admitted that the likeness of His Royal Highness is an admirable one. This die will be used in future for the Society's medals. The first medals to be struck from it will be those awarded for papers during the past session, which will be presented to the recipients by the Chairman at the opening meeting of the new session in November next. An illustration of the old medal is also given. It will be seen that no change has been made in the reverse.

Society's New Medal.

Society's Medal from 1863 to 1900.

A NOTE UPON ENAMELS.

By Charles S. Tomes, M.A., F.R.S.

It has long been known that if it is desired that enamels shall be brilliant and transparent, it is essential to wash the enamel after it has been reduced to fine powder, prior to its application to the work, rejecting the lighter portions, which eventually settle from the washing water as a fine mud, and that the coarser the powder the more brilliant the fused enamel will be. But although the fact is known empirically its rationale is not well understood, and indeed I cannot find that it has ever been carefully investigated, although more or less unsatisfactory explanations have been offered. With a a view to ascertaining what really happens I lately undertook a short series of experiments, which seem to throw light upon the question. I first took an ordinary transparent flux, of fairly high fusing point, and applied portions of this after powdering in an agate mortar to a piece of gold, one portion being unwashed, and the other thoroughly washed. The former, the unwashed, fused into a very cloudy film, which, on microscopic examination, was found to owe its opacity entirely to an infinite number of very minute round air bubbles; no solid opaque particles could be found in it, nor was the matrix between the bubbles at all opalescent. The washed sample yielded a perfectly transparent, colourless film, which on being examined was found to contain but few air bubbles, and these of large size. It therefore appears that the dirty cloudy look of an unwashed enamel is due to the dissemination all through it of exceedingly small bubbles, and not to any opacity in the material itself; this agrees with the statement made to me by a very experienced worker in enamels that an unwashed enamel, or the rejected mud from washed enamel, always yields what he termed a "rotten" coating. Several experiments having given precisely the same result it remained to discover the cause of the bubbles. In Mr. Cunynghame's valuable "Art Enamelling upon Metals, 1899," it is suggested that "The reason why the mud becomes opaque when fused upon the metal is, I think, that a portion of the colouring matter is separated, and that the enamel becomes partly decomposed by the action of carbonic acid upon the alkali which it contains. The carbonates of soda or potash thus formed become, on heating, again decomposed by the silica, and minutes bubbles of carbonic acid gas are formed."

This explanation from a chemical point of view did not appear to me probable, and it admitted of being readily tested in several different ways. A small portion of very cloudy enamel was rapidly crushed in a few drops of distilled water, passed through a tiny filter, and the filtrate produced no precipitate with lime-water. It was, therefore, pretty certain that the bubbles did not contain free carbonic acid gas. A portion of transparent enamel was powdered, dried and weighed in a very sensitive balance; it was then rubbed up with distilled water for some time and left in the water for four hours; it was then repeatedly washed, being allowed time to settle before pouring off the washing water. After being again dried its weight was found to be unchanged, with the exception of a very trivial loss, accounted for by the opalescence of the first washings.

A further portion was weighed after being coarsely powdered, then rubbed down into very fine powder and thoroughly washed. The residue was thrown upon a weighed filter, washed and dried, and then again weighed. The washings, which had they been allowed to settle would have deposited "mud," were also passed through a weighed filter, dried and weighed again. The sum of the two weights amounted to just that of the original powder with the exception of a very small loss, which was anticipated, as the filtrate after repeated filtration remained slightly opalescent. It is astonishing to find that when a glass is powdered even coarsely some part of it passes almost at once into a powder of such extreme fineness that it passes through a filter, and the longer the powdering is continued the more of this exceedingly fine powder is formed. It is this which is got rid of by washing, and it is this which by its presence causes opacity in the fused enamel.

But it is hardly conceivable that any chemical change can have taken place without alteration of weight; if carbonic acid were taken up, as suggested by Mr. Cunynghame, there would be an increase of weight, while if any soluble material were removed there would be loss. And microscopic examination of the coarser portions and of the mud reveals no difference in the particles except in their size; each alike consists wholly of angular transparent particles. A further portion of powdered enamel was digested for some hours in a saturated aqueous solution of carbonic acid, and on drying and weighing was found to have undergone no change in weight.

In all these cases the filtrates, after being left for some days to settle, so as to get rid of the slight opalescence, and then decanted, yielded no residue on evaporation. It may, therefore, be concluded that no chemical change takes place, but that the inclusion of air in the ultimate fused enamel, when this is opaque, is due to mechanical causes only. Probably what happens is that the very fine particles, especially on the surface, become very quickly aggluminated by the heat of the furnace, entangling between and beneath them an infinity of fine bubbles; but that when coarser particles are fired they run together more slowly, and then the air escapes for the most part, the little which remains forming large bubbles which do not practically interfere with the transparency. No transparent specimen of enamel fused on metal which I have examined was ever quite free from bubbles, while the opaque specimens were virtually consolidated froth.

In one instance only did I meet with a different

result. In this case the enamel was an opaque white of very low fusing point. If this was kept, after being powdered, under water for a few days it was found to have gained weight on being dried, and when fired it swelled up and frothed to such an extent as to be absolutely useless, behaving just as a crystal of borax does when heated. A portion of this powdered, steeped in water for two days, dried at 100 C, and then heated into redness in a hard glass-tube gave off water as it frothed up. In this case therefore it was evident that the fused mass as sold contained some salts which were anhydrous, but which were capable of becoming hydrated by soaking in water. It is a common practice to add borax to a glass in order to lower its fusing point, and it seems probable that this sample contained a large amount of borax or of some borate capable of taking up water of hydration.

But this I have met with only in this one sample; no other has shown any change by being kept under water. Enamels of various colours have been experimented upon, but with no difference of result.

The above experiments appear to prove that water, at all events in short periods of time, exercises no chemical influence upon the enamels; hence, if there really be any advantage in employing a non-aqueous fluid, such as paraffin, during the powdering process, as has been suggested as an improvement, the benefit must be due to causes other than those supposed by its advocates.

When, however, an enamel reduced to impalpable powder is used in a sufficiently thin layer, most of the air is able to escape before the surface glazes, and so a fairly transparent film is obtained.

RECENT EXPERIMENTS IN MECHANICAL FLIGHT. *

In the experiments of Gaston Tissandier, the balloon was made cigar shape, both ends being practically alike. The propelling force was a screw driven by an electrical engine. The machine was very carefully made, and was probably as beautiful a piece of workmanship as ever has been turned out. It was inflated with pure hydrogen. When it was tried, it rose in the air to perfection, and moved at a low velocity by means of its own screw and motive power; but the velocity through the air was considerably less than the velocity of the air itself, consequently it moved along with the wind very much like any other balloon. Other experiments were made, and it was found that the cigar-shape was not so favourable as a fish-shape balloon. Captain Renard constructed several balloons, the greater part of which were fish-shaped, that is, full forward, and slim and tapering aft. In these balloons the very best accumulators and electrical engines were employed for propelling a screw of large diameter that was used. On one occasion, in a dead calm, the balloon ascended, travelled some three or four miles, and returned to the point of departure. It was drawn down and put back into the shed, where it had been built, and this is, I believe, the only instance in the history of the world where a balloon has returned to the point of departure.

* A paper read by Mr. Hiram Maxim before the Aeronautical Society, July 17, 1900.

Many other experiments have been made by Captain Renard, who is, as is well known, employed by the French Government, and who has unlimited means and assistance at his disposal.

But in no case, except in the one just mentioned, has he succeeded in making his balloons return to the point of departure. It was told to me by one of his assistants that the balloons only travelled about four miles an hour, and as the wind always blows a little more than four miles an hour, they were sure to travel with the wind exactly as all other balloons had done before.

In regard to the recent experiments of Count Zeppelin, it appears that a very large and expensive balloon was constructed. To prevent all the gas from getting into one end of its elongated form, as often happens, a considerable number of compartments were employed, each of which was filled with hydrogen gas. Instead of using an electrical engine, as had been employed in France, he used a much stronger and lighter motor, viz., a petroleum engine. The French, whilst acknowledging that a petroleum engine developed more power for its weight than could be obtained by electricity, appeared to be afraid to employ it on account of the great liability of igniting the gas in the balloon.

In the first accounts of these German experiments, it was said that the balloon travelled 30 miles. We then hear that it travelled about three miles, and was finally towed back to the shed where it had been built. As all the information I have at hand is based on newspaper reports, and no two of these are alike, I do not feel that I have sufficient reliable data by me to draw any conclusions. I would, however, say that it appears to me quite useless to endeavour to make a balloon that would travel against the wind. A balloon, in the very nature of things, has to be lighter than the same volume of air. Its density is therefore very small. In order to be of sufficient size to lift itself, and any considerable load, it necessarily has to be of very great dimensions, and being of great dimensions, and as one might say, very soft and fragile, it cannot be made to travel against the wind. As before stated, balloons always have travelled with the wind, and it appears that this new German balloon is no exception to the rule. The experiments of Professor Langley, Mr. Horatio Phillips, and myself have been sufficiently successful to demonstrate that not only great lifting effect but also propelling effect may be obtained by the use of aeroplanes and screws, that is, with true flying machines—machines heavier than the air. But these experiments are extremely expensive, and require a great deal of time. Flying

machines are sure to come in the immediate future. We certainly have enough skill in England to build one; I think the same may be said of the United States of America. In France, however, although they may have no more skill than we have, the abundance of money which they have at their disposal gives them a great advantage.

In regard to the use of flying machines there can be no question but what at first they will be rather risky things to play with. Their primary use will be for warfare. I think I may say that the danger of navigating such a machine, and of reconnoitring an enemy's position will not be greater than any other form of reconnoitring—in fact, I should say it would be infinitely less. I think flying machines would also be of great value for conveying despatches over difficult country in time of war, to say nothing of occasionally dropping a bomb into the place where it would do the most good.

Flying machines like automatic guns make war more difficult and expensive. They will give to the highly civilised nation which has both money and engineering skill, great advantages over poorer and less skilful nations, which will, of course, be a potent factor in extending the borders of civilisation, or, as one might almost say, of civilising the world.

PROFITABLE SANITATION.

The following letter from Dr. Vivian Poore, F.R.S., appeared in a recent number of *The Times*.

Sanitary works which have not been a ruinous expense to ratepayers are so rare that I trust you will allow me to call public attention in your columns to the highly successful issue of an experiment which we owe to the spirited action of the city of Manchester. This experiment has not yet attracted that amount of public attention which it merits, possibly because no patents nor royalties are involved in it. All big cities are confronted with the difficulty of getting rid of their accumulations of refuse both organic and inorganic. The difficulties of Manchester have been unusually great because the ordure from nearly 80,000 small houses has to be systematically removed and dealt with.

Travellers between Manchester and Liverpool on the North-Western line are familiar with a tract of boggy moorland, part of which, known as Chat Moss, caused no little trouble to George Stephenson.

It was in 1886 that the city of Manchester bought part of this moorland with the object of providing an outlet for its refuse. The part so purchased, known as Carrington Moss, is separated from Chat Moss by the ship canal, which now affords a ready means of transit between the city and its estate.

The nearest railway station to Carrington is Flixton, and the mile or so of road between the station and the Moss is none of the best.

It was in August, 1898, that I paid my first visit to Carrington, and what I saw was, to me, so interesting that I repeated my visit on July 21 last.

The Carrington estate is 1,100 acres in extent, and when it passed into the hands of the city in 1886 the greater part of it was let for 1s. an acre for sporting rights. The estate was mainly an unmitigated peat bog having an average depth of about 13 feet. Considerable sums have been spent on the construction of a wharf and farm buildings, the cutting of deep trenches to facilitate drainage, the making of roads, and the provision of narrow tram lines.

In 13 years this estate has received more than half a million tons of refuse from Manchester—ordure and muck for fertilizing, clinker and hard material for road making—and to-day the city finds itself in possession of one of the most fertile tracts of land in the country, the whole of which is let to first-rate tenants at an average rental of £2 per acre. These tenants use some 25,000 tons per annum of manurial matter, for which they pay the corporation at the rate of 1s. 3d. a ton, and thus the Carrington estate returns some £3,500 per annum to the ratepayers, while the outgoings tend gradually to dwindle.

Let me say emphatically that Carrington is not a "sewage farm." The muck is dry, and is spread on the surface of the land and ploughed in in the ordinary way. There is no excess of water. Sewage farming in which the living humus is drowned by tons of water leads surely to agricultural bankruptcy.

At my visit in 1898, and again in July of this year, I had ocular proof of the fertility of this reclaimed land. The hay harvest was just over, and had been a good one, and the standing crops of wheat and oats, potatoes and carrots, would be hard to beat in any part of England. The wheat was especially good, and one field of 17 acres, which Mr. McConnell, the manager, estimated would yield over 40 bushels to the acre, was certainly the finest I have ever seen. Much of the land is now passing into the hands of nurserymen and market gardeners. The ornamental shrubs (except conifers, which have no appetite for manure) were in splendid condition, and I am told that these nursery gardens are exceptionally brilliant when the rhododendrons are in bloom. The physical change which has taken place in this bog as the result of the agricultural and other operations which have been carried out upon it is very interesting. The downward drainage by the deep trenches, and the upward drainage by the heavy crops, which to a large extent prevent the rain from percolating, have resulted in the sinking of the surface and the general compression of the bog so that the land tends steadily to get firmer. Formerly, when ploughing, it was necessary to put "pattens" upon the horses' feet in order to prevent them from getting "bogged," but this necessity, I was informed, now seldom arises.

The farmhouse at Carrington stands on solid and deep foundations, but that the land around it is gradually sinking is well shown by the fact that it is found necessary to provide an additional step for the back door at recurring intervals. Between 1898 and

my late visit a new step had been placed. At my visit in 1898 Mr. McConnell, who then occupied the farm at Carrington, gave an interesting demonstration of the character of the soil by driving an iron rod, $11\frac{1}{2}$ feet long and half an inch in diameter, vertically through the turf of his lawn up to the handle. I easily did the same thing, for the rod having passed the first foot or so met with little resistance, and when withdrawn was found to be streaming with moisture. Mr. Carter, the present occupier of Carrington, kindly allowed me to repeat the experiment at my late visit. I managed with some difficulty to drive the rod into the soil for about 8 feet, but the increasing resistance prevented one from driving it completely "home." When withdrawn, the rod was not wet, but was coated with moderately moist soil. The rapid desiccation and consolidation of the moss was thus made evident.

I would respectfully suggest to the corporation of Manchester that this great experiment merits systematic observation by men of science. A few "surface" wells for the periodic examination of the water by chemists and bacteriologists are much to be desired, and the changes of earth temperatures, the progressive alterations in the physical condition and the flora and fauna of the soil ought to be systematically recorded.

The success attained at Carrington Moss has induced the corporation to purchase some 2,500 acres of Chat Moss which is now being subdued under the experienced guidance of Mr. McConnell, so that, eventually, the corporation will be in possession of a fertile estate of 3,600 acres. Allowing 10 per cent. for roads and other works they will have about 3,240 acres under cultivation, or land capable of producing annually 13,000 quarters of wheat and 8,000 tons of straw where none grew before. Assuming that the land is capable of receiving 20 tons of refuse per acre *in perpetuo*, the city will be in possession of a "destructor" capable of consuming about 65,000 tons of organic refuse per annum, and each ton of refuse will ultimately return about a bushel and a half of wheat and $2\frac{1}{2}$ cwt. of straw (the chief ingredients for 100 lb. of bread and perhaps 1,000 straw hats).

This, surely, is better than burning or fouling rivers. This Manchester experiment should set us all thinking. Is there no possibility of bringing about a profitable interchange of produce between the great cities and the unreclaimed bogland of Ireland? Is there not here a lesson for the consideration of every village council throughout the kingdom—a lesson which has been taught, not by the Utopian dreamer, but by hard-headed men of business?

LIQUID FUEL.

The subject of liquid fuel has again been discussed before the French Society of Civil Engineers with special reference to the establishment of supply stations for ships of war. Evidence exists of the increased use of liquid fuel in British vessels trading to the Far East, the installation of a charging station at Suez having been authorised by the Egyptian Government, and for railway and other purposes in Russia, America, and other countries. M. H. Guérin has contributed to the *Génie Civil* of May last an article on this subject, which is quoted in the last number of *Science Abstracts.* M. Guérin refers to previous articles in the *Génie Civil,* and to a paper in the *Engineering and Mining Journal* of New York by H. Tweddle which describes the best methods of using this fuel and of which M. Guérin's article is to some extent a *résumé.* The best results have been obtained by the use of crude petroleum.

The proportions of carbon, hydrogen, and oxygen in various hydrocarbons and their calorific power (in calories per kg.) are given in the following Table :—

	C.	H.	O.	Calorific power.
Light petroleum oil—American	86·894	13·107	—	10,913
Refined	85·491	14·216	0·293	11,047
Petroleum spirit	80·583	15·101	4·316	11,086
Crude petroleum	83·012	13·889	3·030	11,094
Light oil from Baku	86·700	12·944	—	10,843
Petroleum from the Caucasus	84·906	11·636	—	10,328
Ozokerite from Boryslaw	83·510	14·440	—	11,163

To realise the theoretical calorific power and the highest temperature of combustion it is necessary to supply to the combustible the exact quantity of air furnishing the necessary amount of oxygen, and to have the most intimate possible contact between the air and the fuel. Consequently gaseous fuel offers the best conditions for obtaining the best result, liquid fuel the next, and powdered solid fuel the next in order, although in practice excess of air, deposits of soot and other causes prevent more than a moiety of the useful effect being realised, especially in the case of coal firing. The methods of using fuel in the liquid form are, however, the most simple of all, and hence the repeated efforts towards a more general introduction of this kind of fuel.

Various forms of injectors or "pulverisers" which have been from time to time proposed and introduced are enumerated by the author, and the effects of different forms of jets on the completeness of the pulverisation of the oil and its admixture with the air are discussed. The most suitable form of flame for a given furnace or process depends upon the quality of the oil and on the purpose to which the heat of combustion is to be applied.

Tweddle has found by experiment that in order to obtain the highest possible temperature from liquid fuel it is necessary to burn it in fire-brick combustion chambers of limited capacity, and that for evaporative effects an injector worked by steam is preferable to one using an air-jet which is more suitable for re-

heating, forge, and other furnaces of that class. The author introduced the use of petroleum fuel on the Oroya Railway in Peru in the year 1890, where experiments had to be conducted under unfavourable conditions. Starting from sea-level at Callao, the railway crosses the Andes at an altitude of 4,250 metres, with a total length of about 160 kilometres. The gradients and curves are consequently against the realisation of a high duty. Nevertheless, the consumption of oil was was little over half that of coal although the calorific power of the oil as compared with that of the coal was only as 1·4 is to 1.

The apparatus used on this railway is described in detail with illustrations of the burner, or pulveriser, and of the type of furnace employed.

The evaporative effect produced by firing boilers with American petroleum was in 1896 found by the Weyher and Richemund Company to be 12·5 lbs. of water per lb. of fuel; at the power station of the electric tramways of Los Angelos it was 12·89 lbs.; and in other experiments, with Borneo petroleum, 758 grammes of oil produced the same results per H.P. hour as 1,030 grammes of Newcastle coal. At the last Exhibition in Chicago the steam boilers, working at about 125 lbs. per square inch pressure of steam, gave with mineral oil fuel an evaporation of 14·25 lbs. of water per lb. of combustible as against 7 lbs. per lb. of coal. The theoretical evaporative power of carbon burning to carbon dioxide is 15 lbs. of water at boiling-point under atmospheric pressure.

In steamships it is necessary to use heavy oils igniting at 121° to 149° C., in order to guard against the risk of fire, these oils being quite safe even if a bar of red-hot iron be plunged into them. Experiments made by the French Government on the use of petroleum in torpedo boats proved that it is too dangerous for use in such vessels.

Tweddle made experiments by firing cannon-balls and shells into a pile of casks containing benzene, with the result that the flame from the exploding shell frequently set fire to the benzene vapour. Practically the same effects were produced with kerosene and crude petroleum, but with oil igniting at 115° C. no flame was produced even under much more severe tests. If the oil employed has a sufficiently high point of ignition it offers greater security from fire than coal, and much more than powdered fuel in bulk, both under the conditions of warfare and under ordinary conditions in which spontaneous combustion sometimes occurs.

The handling and storage of liquid fuel are also a much more easy matter than is the case with coal; the necessary appliances are fewer and more simple, and the minimum of labour is all that is required. There are also other minor advantages, not the least of which is the saving of space on board ship for storage of fuel.

In furnaces used in the industrial arts some of its advantages may be realised, where a high temperature and a pure flame are desired, and when the price of coal is high. The author gives some illustrations of such furnaces, and, in particular, of one designed by Tweddle for the combustion of benzene.

SOUTH AUSTRALIAN PERISHABLE PRODUCE.

That refrigeration is destined to play an important part in the development of the rural industries of the colony of South Australia, in common with other parts of Australia, is becoming more and more apparent every day. It is some years ago now that attention was first directed to the importance of encouraging the export of what was termed "minor products," but it is only comparatively recently since steps have been taken in real earnest to place on the markets of the world the perishable goods of the province, which, had it not been for refrigeration, would still have to be limited to home consumption. It was only in April, 1895, that the Government freezing works at Port Adelaide—the only establishment of the kind in the colony—was formally opened, but the trade which they were intended to foster has grown to such an extent that it has been found necessary, on a number of occasions, to enlarge the storage capacity and freezing ability, and even now further important additions are being made. With all this it is recognised that the trade is only in its infancy. It may interest readers to know what has been done in the way of exporting perishable goods since the depot was started, and in this connection the following official figures will be of assistance:—

Yr.	Fresh fruit.		Frozen meat.		Frozen rabbits.	Butter.	
	Pkgs.	£	Lbs.	£	£	Lbs.	£
1895	886	219	64,506	959	—	1,017,629	48,046
1896	1,072	366	432,182	5.594	—	242,872	11,806
1897	12,645	4,341	157,862	1,968	—	16,240	813
1898	3,927	1,664	908,909	13,075	10,700	389,836	14,610
1899	12,796	4,768	2,585,726	36,289	12,198	894,992	44,318
	31,326	11,358	4,450,185	57,885	22,898	2,561,569	119,663

These figures represent exports to the United Kingdom only. The frozen meat trade is confined almost exclusively to lambs, only small quantities of mutton being sent away. This trade is a direct outcome of the establishment of the Government Freezing Works. The chief market so far is that of the mother country, but a fair amount of business is done with South Africa. The frozen rabbit trade is of more recent growth still, but it promises to do not a little towards ridding portions of the country of a veritable pest. The fresh fruit export does not, of course, depend upon the existence of freezing works at this end, though it is significant that the connection with over-sea ports dates back to the entry of the Government into the produce trade. On this account, and also because it is only of recent years that the steam-

ship companies trading to these parts have seriously applied themselves to the task of carrying such delicate cargo, the statistics are worth reproducing. Apples and oranges as yet constitute the bulk of our shipments, but owing to the Government department, charged with the collection of statistics, not being so alert as to recognise a new industry as that other Government department which went to the trouble of assisting the growers to ship, the figures do not distinguish between the different kinds of fruit exported. Other markets, notably South Africa and Java, have been opened for our apples, and growers are finding they are able to ship to these parts without the assistance of refrigeration. A bonus was paid by the Government for the export of butter before the establishment of the Port Adelaide works, but the produce was then prepared for shipment in Adelaide. Apart from the actual freezing of meat, the whole of the perishable produce trade is tending to pass out of the hands of the Government, and, indeed, has largely passed already into those of private firms. Whoever does the business, however, the important point to remember here is that refrigeration has opened up to our producers enormous markets hitherto closed to them, and they have already tasted too much of the advantages to be derived from this to draw back. In the future you may expect to see increasingly large quantities of South Australian lamb, rabbits, butter, and fruit on tables in Great Britain.

If results could be judged merely by the amount of trade done, the 1899-1900 lamb season would be a record one. Shipping extended over a rather longer period than usual, owing to the war interfering with the regular running of some of the refrigerated steamers. From August last year, when the season opened, to April last, when the depot was cleared of carcases, we sent away 90,914 carcases of lamb and 1,334 carcases of mutton. Unfortunately, however, the local market ruled too high during the greater part of the buying season, or what was the same thing, the London market ruled too low, and it is to be feared that profits will be very small in most cases. However, the shippers are in no worse position than those of the other colonies. Prospects for next season are bright.

From every point of view a most successful apple season has just been concluded. The mail steamer, which left Adelaide at the beginning of May, took the last of the season's apples for London, though consignments will continue to be made to the Cape and the Far East. Mail-steamer shipments have amounted to 12,198 cases, compared with only 7,149 cases last year, 2,175 cases in 1898, anp 10,542 cases in 1897. It will thus be seen that this year's shipments to London have been the largest yet made, and as trade in other directions is also extending, it is quite safe to refer to the present season as witnessing high water mark in exports. Though a long way behind Tasmania, this colony is second on the list of apple-exporting colonies, and our growers have the satisfaction of knowing that their fruit not infrequently tops the market as far as value is concerned. Up to the present the cabled prices obtained for fruit which has been landed have been such as to leave a satisfactory profit to exporters. Oranges will next engage attention, and already one of the large growers at Salisbury, not many miles from the city, is preparing 500 cases for the London market. The carrying of grapes, pears, and peaches to the other side of the world has scarcely passed through the experimental stage with us. It may be mentioned, however, that a trial is now being made with these fruits at the Government depot. About seven weeks ago, some grapes and peaches were packed according to the Sutherland process, and subsequent examinations have demonstrated that these fruits, if properly selected and packed, can be kept in good condition sufficiently long to enable them to be carried to London.

The rabbit season has opened by the steamer *Wilcannia* taking the initial shipment of 2,202 crates. The outlook is for larger export this year than last. The rabbits are nearly all obtained from the south-eastern portion of the colony, and the carcases have first to be railed about 300 miles to the freezing works. The railway department has this season provided special cars suitably fitted for the traffic. The skinning is done at the depot. At present the colony cannot boast of a refrigerated lighter, but the question of providing one is even now occupying the attention of a private company. The main advantage of having such a lighter would be the possibility of weekly shipments, but, in addition, direct trade with Liverpool would be fostered.—*British Refrigeration.*

APPLICATION OF ANILINE DYESTUFFS TO LEATHER.

Mr. M. Chas. Lamb, Head of the Leather Dyeing and Finishing Department, Herold's Institute, Bermondsey, read a paper on the dyeing of leather early this year before the West Riding Section of the Society of Dyers and Colourists, which has just been reprinted from the *Journal* of the Society. The author writes:—

"The dyeing of leather I may say without fear of contradiction is the most difficult branch of the art of dyeing. The difficulties encountered by the leather dyer are numerous; one of the many is that skins which have been tanned with different tanning materials take the dye very differently. This is due to the fact that the vegetable material, with which the skins have been tanned, itself contains colouring matter which is imparted to the leather. Another of the dyer's difficulties comes of the very marked and characteristic differences in the fibrous structure of the skins derived from different sources, some skins being open and loose in texture, and others firmer and more compact, which affects the dyeing in that

an open, coarse-textured skin will absorb more dye than will a skin of firmer texture, the resulting shade being much deeper in the former case than in the latter. Skins of the same class, moreover, exhibit in a more or less degree this difference in texture, and it is a fact well known to leather dyers that in a number of skins which have been dyed in the same bath, there are always one or two which are not exactly the same shade as the rest. I have been consulted from time to time by leather manufacturers, who have found difficulty in dyeing level, that is, obtaining in one and the same skin the same shade throughout. This is usually due, not to the dyestuff used, or the method of dyeing, but to the preparatory treatment being insufficient."

Mr. Lamb gives an account of the operations preliminary to the actual dyeing, and then proceeds to describe the three distinct methods of dyeing in use in this country, viz., the "tray," the "paddle," and the "drum" methods. He specially alludes to bookbinding and furniture leathers, and refers to the movement among bookbinders, and others interested in the preservation of books, for the investigation of the causes of decay, which has caused the appointment by the Council of the Society of Arts of a committee to consider the whole question of leather for bookbinding. Mr. Lamb writes:—

"During the past few months there has been considerable controversy amongst the principal bookbinders in London with regard to leather used in bookbinding, so perhaps it may not be out of place for me to say a few words on the matter. Bookbinders contend that the leather used in bookbinding perishes in the course of a comparatively short period. The chief cause of these leathers rotting in a comparatively short time is undoubtedly the reckless use of sulphuric acid in clearing and dyeing, and insufficient precautions being taken to remove the acid, or to neutralise it, after dyeing. If the least trace of acid is left in the leather it becomes concentrated in the fibre when the leather is thoroughly dry, and completely destroys the leather. I have here a few specimens of leather that were dyed with acid colours about two years ago; these, as you will see, though the leather was well washed after dyeing, are completely rotten, the fibre being entirely destroyed. I have found that it is practically impossible to remove sulphuric acid from leather by washing in water, as samples of leather which were dyed with the acid colours, and the addition of the requisite amount of sulphuric acid, on analysis, still showed traces of the vitriol, after they had been left in a running stream of water for a period of five weeks. I think that another matter which has been to some extent overlooked by those authorities who have been consulted on the matter by the bookbinders, is the use of soda for stripping the natural tannage of many of the foreign tanned leathers, as I mentioned earlier in this lecture; this, in my opinion, causes the leather to be unreliable, though undoubtedly sulphuric acid is the chief cause of the mischief. In my opinion, bookbinding leathers and leathers for furniture purposes should not be dyed with the acid colours, together with the addition of sulphuric acid. If the acid colours are used, they should be used either without any addition, or, if any, only the addition of acetic acid, or a little bisulphate of soda, which latter agent, so far as I have been able to test, has apparently no injurious effect upon the leather, if not used in great excess. The leather should on no account be stripped of the tanning with an alkali, nor should it be cleared with vitriol or any other acid that has an injurious effect upon leather; practically the only one permissible being acetic acid. It would be much better to use the basic dyes, where no acid is required, when dyeing these leathers, though unfortunately this class of colouring matter has the reputation of not being so fast to light as the acid dyes."

ADMIRALTY SURVEYS.

A brief reference to the interesting report of the Hydrographer of the Admiralty for last year will prove the necessity that exists for unremitting care and vigilance on the part of those to whom is entrusted the task of ensuring the safety of our ships which navigate the seas of the whole world. This important work is carried out under the direction of the Lords Commissioners of the Admiralty, and includes the examination, close inspection, and charting of the seas and coasts in various parts of the globe. The shipping and commerce of all nations benefit by these marine explorations, and to do others justice as well as ourselves, they all share in the great object to be attained. During the year 1899 no less than 274 rocks and shoals, which were dangerous to navigation, were localised, surveyed, and will be marked upon the charts now in preparation. Of these perilous impediments to the safety of vessels of all classes, 194 were reported by colonial and foreign Governments, 23 were discovered by ships striking on them, and the remainder by the chartered surveying vessels and Her Majesty's men-of-war. Summing up, over twelve thousand miles of coast have been surveyed, and an area of between four and five thousand square miles sounded and plotted upon scales, varying according to the position and requirements of the locality. These hydrographical surveys are divided into two classes, home and foreign, and require the services of seventy-eight officers and about seven hundred men.

Passing over the operations carried on, with respect to the east and west coasts of Scotland, which present no particular features of interest, we may direct a little attention to the east coast of England, commencing with Hull. A careful examination of Hull roads, with a view to find a berth for the coastguard ship, revealed the fact that a considerable amount of shoaling—that ever-recurring obstruction to secure navigation—had taken place since the last Admiralty survey, and that the deep water space available did not

afford sufficient swinging room for even a vessel of the *Galatea's* dimensions. The survey, moreover, indicated that a considerable decrease in the available depths, notably in the neighbourhood of Hull Middle Sand, has recently occurred. As this general shoaling is unaccompanied by any deepening of the channel, it may have a serious effect in connection with the future navigability of the river Humber above Hull. Subsequently the surveying vessel proceeded to Goole to ascertain whether the changes in the upper part of the river since the last exploration were of such a permanent character as would justify a survey being made of the river above Hull. The result of a careful examination of local plans and surveys made at frequent intervals in the vicinity of Goole showed that the changes in the channels are so frequent that no chart of that locality would represent the true state of the river for more than a few weeks at a time. The west coasts of England, the Scilly and Channel Islands, offered no new features of importance. At Plymouth the dredging of the Vanguard and Rubble banks, which was carried to a depth of 30 feet below low-water ordinary spring tides, cleared away the Vanguard shoal, rendered it fit for navigable purposes, and removed a great obstruction to the passage of heavy vessels in a critical part of the channel into Hamoaze. Every one who knows Plymouth will appreciate the importance of these operations.

Turning to the foreign portion of the Admiralty surveys, the river Congo was traversed to its furthest navigable point about eighty miles from the sea, and astronomical positions were established along its banks, upon which to base future surveys. In this expedition a series of observations was conducted respecting the movements and the laws governing the general flow of the undercurrents near the mouth of the river, which possesses considerable hydrological interest. It was demonstrated that the fresh water of the Congo extends from the surface to the bottom of the stream, filling, in fact, the entire channel until, as it approaches the coast, it meets with a large volume of opposing salt water. In virtue of its lesser specific gravity, the fresh water dominates the denser, and runs on the top of it, with an increased velocity, but with a greatly reduced depth. As the river widens the layer of fresh water gradually diminishes in depth, until it reaches a minimum of a very few feet near its mouth.

Neither on the west and north Pacific coasts of North America, nor along the littoral of the Red Sea is there anything of note to record respecting the Admiralty surveys of last year, but the exertions of the explorers were rewarded with some substantial results on the west and south coasts of Australia. The survey of the Mary Anne Passage and its approaches revealed the existence of numerous new shoals, exceedingly dangerous to navigation, and many off-lying islands were found to be as much as four miles out of position. The Passage itself was narrower than when formerly charted, which is a matter deserving attention, as this route is much traversed by steamers trading with Freemantle and the north-western ports, and also with Singapore, a traffic which is increasing. In China, Hongkong, Yenghai, and Shanghai, and in India, Rangoon, the river Moulmein, and the Andaman Islands were visited, but it is satisfactory to state that in no case were soundings obtained that would be considered dangerous to navigation. It is gratifying to know that all civilised countries cordially co-operate in the great work of marine surveys. The hydrographical departments of foreign Governments furnish useful and important information relating to all quarters of the globe by the free interchange of new charts and other documents bearing on hydrography. Her Majesty's consuls also contribute much local information for the amendment and revision, as occasion demands, of the Sailing Directions, a great boon to the whole of our numerous sea-going population.—*The Engineer.*

LITHOGRAPHIC STONES IN GERMANY.

The territory in and around the village of Solnhofen, in the kingdom of Bavaria, forms the world's chief supply of lithographic stones. The litho stones found in France, near Montpellier, cannot, it is said, compare with the Solnhofen stones. Consul Weber, of Nuremberg, says that lithographic stone is nothing but a compact and homogenous limestone, and the villages of Solnhofen, Moernsheim, and Langenaltheim, with a population of about 3,000 inhabitants, lie right in the centre of such limestone strata. These cover an area of about ten acres, of which the greater part has not yet been worked. The statement that is made from time to time, mostly from interested persons, that the supply of Solnhofen stones is rapidly diminishing, is, therefore, absolutely without foundation. These stones will not be exhausted for the next 200 years at least. Rumours of newly-discovered litho stone beds in other countries have, so far, proved to be untrue, or the stones found have turned out to be of little use. At the present time litho stones must be of excellent quality in order to satisfy the requirements of the art. Many stones found at Solnhofen are laid aside as not coming up to the standard. These are sold to builders, and are used for paving floors, &c. A scarcity, therefore, of superior lithographic stones, if it should ever arise, would have the effect of bringing into the market inferior stones. It is interesting to note that the stones in Solnhofen do not lie deep in the ground; in fact only the earth and some rock have to be removed as a rule. The stones lie in layers, and have simply to be taken carefully from the earth. The bulk of the ground, beneath which the litho stones lie, belongs to the communities of Solnhofen and Moernsheim, and therefore each Gemeindebürger (homestead owner) of these com-

munities has a share in the ground. From time to time the aforesaid communities measure out a new stretch of land and divide it into lots, and each Gemeindebürger gets his part. He can either explore the ground himself or sell his claim to one of the larger owners. The ground itself, after it has been deprived of its costly treasure, becomes again the property of the community. Blue or grey lithographic stones are the most costly ones, as they are harder and better for use, and more copies can be obtained from them. Being harder, they stand the polishing on both sides better than the yellow ones, and therefore are chiefly used for exportation to the United States. In fact the United States takes only these double-faced stones, which can be worked by the printer from both sides. The Germans, on the other hand, are wont to use single-faced stones. Every stone does not take polish on both sides; a stone may be good on one side, while on the other it is unfit for use, has flaws, splits, &c. Such blemishes are not always apparent on the surface, but may come on when the stone is worked upon by the printer. It requires, therefore, skilled workmen, who have been in the trade from their childhood, to see that none but good stones leave their hands. Solnhofen lies very far inland, and therefore the freight rates to all the seaports are high. River transportation is seldom used. The stones are sent by rail to Bremen, Hamburg, Rotterdam, or Antwerp. If destined for the United States they go mostly to Bremen. The entire output of stones is estimated to amount in value to £120,000 annually. Of this, England takes one-fifth, the United States one-sixth, Germany and other countries taking the remainder.

AMERICAN PIG IRON IN 1900.

Statistics of the production of all kinds of pig iron in the United States to June 30, 1900, have just been published by the American Iron and Steel Association, the particulars having been obtained from the manufacturers. The association also publishes complete statistics of the stocks of pig iron which were on hand and for sale on the above date. From this report *The Times* quotes and says that it appears that the total production of pig iron in the first half of the present year was 7,642,569 gross tons, against 6,289,167 tons in the first half of last year and 7,331,536 tons in the second half. The increase in the production in the first half of 1900 over that of the second half of 1899 was therefore 311,033 tons. The total production of the last half of last year and the first half of the present one is 14,974,105 tons, or close upon 15,000,000 tons. The demand for pig iron having slackened it is not expected that the enormous production of the first half of 1900 will be continued in the second half. The check in production in fact commenced in June, when some furnaces were banked and others were blown out. Turning to the qualities produced of the various grades of pig iron in the first half of 1900, it appears that the output of Bessemer pig iron was 4,461,391 gross tons, against 3,788,907 tons in the first half of 1899 and 4,413,871 tons in the second half. Of basic pig iron there were produced in the first half of 1900 581,868 gross tons, against 482,389 tons in the first half of the previous year and 502,644 tons in the second half. The whole of this iron was made with coke or mixed anthracite coal and coke as fuel. The output of charcoal pig iron in the first half of 1900 was 167,146 gross tons, against 128,485 tons in the first half of 1899 and 156,281 tons in the second half. In addition to this there were also produced in the first six months of this year 25,042 tons of pig iron with mixed charcoal and coke. The production of spiegeleisen and ferromanganese in the first half of 1900 amounted to 148,102 gross tons, against 104,496 tons in the corresponding period of 1899 and 115,272 tons in the second half of that year. The total number of furnaces in blast on June 30, 1900, was 283, against 289 on December 31, 1899. The number out of blast on June 30 was 128, against 125 on December 31, 1899. The unsold stocks of pig iron in the hands of manufacturers or their agents on June 30, 1900, amounted to 338,053 tons, against 63,429 tons on December 31 of last year. The statistics of unsold stocks of pig iron do not include pig iron sold and not removed from the furnace bank, or pig iron in the hands of creditors, or pig iron manufactured by the proprietors of rolling mills for their own use, or pig iron in the hands of consumers. Included in the stocks of unsold pig iron on June 30 were 946 tons in the yards of the American Pig Iron Storage Warrant Company, which were then under the control of the makers. The quantity in those yards not under their control amounted to 4,854 tons, which, added to the 338,053 tons first referred to, gives a total of 342,907 tons, which were on the market at that date, against a similar total of 68,309 tons on December 31, 1899. The total stocks in warrant yards on June 30 amounted to 5,800 tons.

DESTRUCTION BY DYNAMITE.

It was reported from South Africa that the Boers recently attempted to destroy a railway tunnel by starting from the opposite ends two locomotives, heavily loaded with dynamite; but these locomotives collided at full speed midway in the tunnel, exploding the dynamite, and, of course, completely wrecking the engines; but (according to a later dispatch) the resultant injury to the tunnel itself was relatively small, and could be repaired easily and rapidly. According to another report, the

official mining engineer of the Pretoria Government, in charge of the Johannesburg gold mines, said that all the mines of the Witwatersrand could be destroyed in two days by the use of dynamite, if such a step should become necessary. The surrender of Johannesburg to the British, however, with the mines intact, disposed of all these reports of contemplated vandalism.

In view of the fact that a proposition to destroy the mines was made and actually discussed, I take occasion not to discuss the ethical aspects of this use of dynamite, as related to the laws of civilised warfare, but rather to point out that "destruction by dynamite" is not so easy as its projectors are accustomed to consider it. This statement, illustrated already by the experience of Anarchists, Fenians, strikers, and inexperienced miners, seems to have received its latest confirmation in the railroad tunnel mentioned above. The fact is, that when the impact of a dynamite explosion is communicated to a large body of air (as was the case in the great Johannesburg explosion five years ago) it may, through that medium, work widespread wreck; but when it is immediately received by solid masonry or rock its energy is largely expended in the molecular work of local pulverisation, being generated too instantaneously, and too simultaneously throughout the mass of the charge, to permit its seeking "lines of least resistance," or following such lines, once found, with the persistence due to a more gradual expansion, such as the slower, progressive explosion of black powder produces.

Thus, in one instance, when put under an obnoxious monument, dynamite dug a big hole in the ground, and pulverised the bottom stones of the monument, but did no further damage. In another case, exploded against the wall of a public edifice, it made a small opening in the immediate adjacent masonry—and that was all. In the recent railway road tunnel experiment of the Boers, the collision and the dynamite together doubtless made scrap iron of the two locomotives, and track ballast of a considerable amount of the rock in the immediate vicinity; but unless the locality of the explosion had been skilfully selected, with a view to collateral results, it is highly improbable that anything more than the clearing away of the rubbish (and, perhaps, some fresh support for walls and roof) would be required to make the tunnel commercially useful again.

The statement of the Transvaal engineer as to the practicability of the "destruction" of a large number of mines in two days may be taken with much allowance. Unless very elaborate and extensive preparations had been already made, and made with much skill, his threat indicated either cheek or ignorance only. Even if such preparations had been made, the rapid and general destruction which he describes as practicable would be so only if innumerable separate and widely-scattered bore-holes, already charged with dynamite, were waiting only for the electric spark to fire them simultaneously. But no sane engineer would dare to create and maintain such a situation as that for more than a day.

The probability, amounting almost to certainty, is that such attempted "destruction" would amount to nothing more than the partial or total wreckage of machinery and buildings, and the production, here and there, of local and limited caving of ground. This would have caused, no doubt, delay and expense in the resumption of mining operations; but it would not by any means have extinguished the Witwatersrand as a source of gold for the use of the world.—*Science and Art of Mining.*

THE GOLDFIELDS OF NOVA SCOTIA.

The Atlantic coast of Nova Scotia from Canso to Yarmouth is occupied by a series of very old rocks whose age, certainly greater than the silurian, is still a subject of debate among geologists. These rocks, consisting of rocks and quartzites, are broken through at numerous points by intrusion of granitic rocks which have induced much local metamorphism. The Inspector of Mines at Halifax, in a report to the Commissioner of Public Works and Mines, states that the rocks have been folded by a force acting at right angles to the general trend of the shore into numerous plications having a general east and west course. The fold have usually high dips, and the anticlinal crests, where cut off by denudation, show layers or veins of quartz intercalated with the slates and quartzites. These quartz fillings occupy the spaces formed between the layers of rock by the compressing and elevating force, and are frequently auriferous. These anticlinal crests are very numerous, and the veins in some of them have been worked for a long time. Recent experience has shown that the most productive veins lie close to the course of the anticlinal, and that many veins producing gold do not come up on one side of the anticlinal axis, and drop down again on the other side, but turn over and descend again without coming at all to daylight. The veins vary in thickness from three inches to 12 feet, and their gold contents run in the worked veins from four pennyweights to 20 ounces per ton. In the richer veins the gold usually occurs in zones or bands in the veins, lenticular in shape, and usually with a decided dip to the east or to the west. In some veins, however, the gold occurs in irregular pockets, apparently following no fixed law of deposition. The veins carry, in addition to gold, iron, copper, zinc, and lead sulphides, and frequently show considerable percenteges of arsenical pyrites. These minerals are not valuable as a source of supply of the metals they are composed of, but are sometimes saved in the mills to be treated a second time for the gold they contain. Hitherto mining on these veins has been carried to a limited depth only, the deepest shaft not having reached 700 feet, while the average depth does not exceed 200 feet. The veins being usually in firm rocks with well-defined walls, are

opened by shafts sunk on their dip. Mining costs vary with the condition of each vein, but it may be asserted that the expenses of mining, pumping, and hoisting are lower than in any similar class of works elsewhere. The compact nature of the rocks renders the workings, when proper precautions are taken to exclude surface waters, so dry as to give very small pumping costs. The quartz passes from the mine without dressing, &c., to the mill which is usually driven by steam. The mills are almost invariably stampers, and vary in size from five to thirty-five stamps. The pattern of the mills is based on the best United States models with improvements suggested by local experience. As the quartz carries its precious burden, as coarse and free gold, amalgamation is carried on in the mortar and on plates. The gold bullion is of good quality carrying little silver. The production of gold during the year 1899 was in round numbers about 30,000 ounces, from a dozen localities. The business, although small, is, when pursued methodically, remunerative, and is capable of unlimited extension, as there are numerous anticlinals unworked, and many more to be discovered in unexplored districts. The mines are all within easy reach of roads, and of the harbours along the coast, and aid is furnished by the Provincial Government in opening roads to new mines. The Nova Scotians make excellent miners, and prefer this work to almost any other occupation.

JIPIJAPA OR PANAMA HATS.

Ecuador is the real home of the hats wrongly designated under the name of "panama," and according to the *Recueil Consulaire Belge* this industry afterwards extended to Peru and other countries, even to Yucaton in Mexico. Everywhere in Latin America the hat is known under the name of "Jipijapa" in honour of the city where its manufacture was first started. It is only in Europe or outside of the producing countries that this hat receives the name of a city which does not make it. The finest hats are made in Jipijapa and at Montecristi, in the province of Manabi (Ecuador), this industry being one of the greatest resources of the country. The *toquilla* or leaf of a small plant is used for this purpose. It grows abundantly in the country the leaves coming up in the shape of a fan. The plant is the *carludovica palmata.* There are jipijapas of all qualities, from those costing a few pence to those worth several pounds. The merit of these last, really marvels of fineness, consists as much in the scarcity of the straw as in the difficulty of the weaving, and therefore it is exceptional to find these hats on the general market. The hats of current sale cost a few shillings, the finest not exceeding from £5 to £6 in price. In buying a panama it is necessary to ascertain two things—that the straw is whole and that it is not stiffened. It is not easy to recognise this first condition. In order to make two from one, the weavers split the straw with such perfection that unless a person is accustomed to such examinations it is almost impossible for him to distinguish the difference. Of equal fineness the hat made from whole straw is worth three or four times the one manufactured from the straw that has been split. The second condition is easily recognised for the hats are stiffened to make the straw firmer and white. Good *toquilla* is white and stiff enough not to need any gum, and only ordinary panamas are stiffened.

General Notes.

Manchester Dock Extension.—A great scheme of dock extension has been prepared in connection with the Manchester Ship Canal. No fewer than 142 acres of land will be added to the dock estate. Those who have followed the returns know how greatly traffic has increased on the Ship Canal. Spare land has gradually been absorbed, spaces allotted to open-air cargoes have been covered by transit sheds for general cargoes brought by huge vessels from Canada and the United States, and last summer even the railway sidings were covered with timber stacks. Since the appropriation of the Liverpool timber docks for the use of the regular Atlantic liners, there has been a general transference of the timber trade to Manchester, and this circumstance alone is sufficient justification for the works now proposed. Consequent upon the increased cost of labour and fuel, the railway companies have exhibited a disposition to raise the rates of transport, as in Scotland, and to enforce charges for waggon hire, demurrage, weighing, and other items which have been more or less overlooked in the past.—*Feilden's Magazine.*

Munich International Art Exhibition, 1901.—The eighth of a series of International Art Exhibitions will be held in the palace of Grass at Munich in 1901, and will be promoted by the Munich Artists' Club, and the Plastic Art Union of Munich. It will be conducted for the most part on the same principles as the last Exhibition (the seventh), which was held in 1897. Special efforts will be made to secure success in view of the eightieth birthday of the Prince Regent of Bavaria. The co-operation of British artists is cordially invited. The Exhibition of 1897 comprised painting, sculpture, etching and engraving, and design, both as illustrated by drawings and as carried out in materials. Further information can be obtained upon application to the Secretary of the Artists' Club (Künstler Genossenschaft), Munich.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

H.R.H. THE LATE DUKE OF SAXE-COBURG AND GOTHA, K.G.

The following address to H.R.H. the Prince of Wales on the occasion of the lamented death of H.R.H. the Duke of Saxe-Coburg has been presented to His Royal Highness, the President:—

The Council of the Society of Arts desire to give expression to the profound feeling of sorrow with which they have heard of the death of H.R.H. the Duke of Saxe-Coburg and Gotha. For nearly thirty years His Royal Highness was a Member of the Society and of its Council, and while resident in England took an active participation in much of its work. The Council deplore his loss, and they venture to hope that H.R.H., the President of the Society, will accept the assurance of their most heartfelt condolence, and will also graciously undertake to convey to the Queen their loyal and dutiful sympathy with her Majesty in her grievous bereavement.

(Signed) John Evans,
Chairman of the Council.
H. T. Wood,
Secretary of the Society.

7th August, 1900.

MEMORIAL TABLET TO JOANNA BAILLIE.

A tablet has just been erected by the Council of the Society on the front of Bolton-house, Windmill-hill, Hampstead, to commemorate the fact that the celebrated poet—Joanna Baillie—lived there for many years, and was there visited by the most celebrated men and women of her day. The inscription on the tablet, which is placed between the windows of the first floor, is "Joanna Baillie, Poet and Dramatist, born 1762, died 1851—lived in this house for nearly 50 years."

Bolton-house is one of three (the centre) old-fashioned, red-brick houses, with trees in front, and is entered by iron gates. It is still in a somewhat retired position, although many new houses have grown up around it, but it may be safely asserted that at the beginning of the century the neighbourhood was, after dark, by no means pleasant for solitary walkers. In a letter to Joanna Baillie, dated 1811, Sir Walter Scott described the fright he had when leaving her house in the evening. He wrote "I foolishly chose to take the short-cut through the fields, and in the enclosure where the path leads by a thick and high hedge with several gaps. In it, however, did I meet with one of your thorough-faced London ruffians—at least judging from the squalid and jail-bird appearance and blackguard expression of countenance." Scott wrote much more as to his fears, and the delight he felt when he got safely within sight of London.

The chief work upon which Miss Baillie's fame rests is the series of dramas, entitled, "Plays on the Passions." Her blank verse has been highly commended by competent judges as possessing a notable dignity and sonorousness, and Sir Walter Scott spoke of her as the "immortal Joanna." She was wanting in a knowledge of stage requirements, and several of her productions were unsuitable for acting, but others met with considerable success on the stage, more especially "De Montfort"—a tragedy, which represented the passion of hatred. This was produced in 1800 by John Kemble, with himself and Mrs. Siddons in the chief characters, and it has been said that the passage in the play, descriptive of Jane De Montfort, formed the best portrait ever drawn of Mrs. Siddons herself. That the great actress appreciated the possibilities of the character may be guessed from her expression in a conversation with the author — "Make me some more Jane De Montforts."

Miss Baillie also wrote the words of several songs, which have had an immense popularity, such as "Up, quit thy bower," "Woo'd and married an' a'," "Saw ye Johnnie comin'," and the "Chough and Crow." In addition to the distinction of her literary work, she will always be remembered by reason of her friendship with such men as Scott, Wordsworth, Southey, Rogers, Jeffrey, Crabb Robinson, and many others; and of the literary gatherings at her house on Windmill-hill, in the first half of the 19th century, where she was assisted as hostess

by her sister Agnes, who survived Joanna by ten years, dying in 1861 at the age of 100. In a letter dated 28th April, 1840, Lord Jeffrey wrote, "I forgot to tell you that we have been twice to Hampstead to hunt out Joanna Baillie, and found her the other day as fresh, natural, and amiable as ever, and as little like a tragic muse." Joanna's mother was the sister of the great physiologists—William and John Hunter, and her brother Dr. Mathew Baillie, one of the most eminent physicians of his time, inherited the house of Dr. William Hunter in London, which by an odd coincidence was in Windmill-street, as well as his fine museum and collections.

Agnes Baillie continued to live at Bolton-house until her death, and she had a number of the windows darkened, so that it came to be called by the children of the Heath, "the house with the black windows."

Miscellaneous.

INDIAN COAL.

A noteworthy discovery of coal on the property of the Bengal Coal and Iron Company was announced lately. Other finds have since been reported from various parts of India, the most important being that referred to at the recent annual meeting of the Nerbudda Coal and Iron Company. It is estimated that this particular deposit contains 10,000,000 tons of good quality fuel—not a prodigious quantity, certainly, but, still sufficient to represent a respectable accession to the reserves of the company. These discoveries of coal in various districts of India are of interest to the United Kingdom in two or three ways. They must help to solve the whole question of India's ability to cultivate a large iron manufacturing industry. One of the principal deterrents hitherto to any considerable development in this direction has been the lack of suitable coal in quantities large enough to ensure a continuity of supplies. We do not know much that is scientifically definite on the subject of the recent discoveries, and it is quite possible that they may be no better adapted than the bulk of that already produced for the purposes of iron manufacture. On the other hand, finds are so numerous, and are being made in so many widely-scattered districts of the empire, that there is every likelihood before long of someone unearthing big deposits of good cokeable coal. In the meantime, it is to be noted that the Nerbudda Company expects great profit from its new seam, for it is to be well understood not that fuel of the right sort is not obtained in India, but only that at present there is no great quantity of it available; and the Indian iron industry could not possibly make strides even in the Indian markets if it had a mind to depend upon the United Kingdom for the necessary coal. The increase of production in the dependency is in another way of very direct interest to us at home, for it implies a decrease in the imports of steam coal for railway and factory consumption. Every ton mined is used up, and were double the quantity obtainable there would be little difficulty in disposing of it. For though in steaming qualities Indian coal is poor enough, as compared with that of South Wales, it is possible by the adaptation of furnace bars to use it with good results, and allowing for its initial inferiority, there is a great saving in fuel bills by its employment. The reason for this is quite clear. The chief colliery districts are not very remote from the centres of industrial consumption, especially Calcutta; they are in communication with railways, and what may not be used by the railways is snapped up eagerly by the mills. It is the misfortune of not a few localities where coal occurs in great profusion that they have not yet been brought within the network of railway lines that is gradually spreading over the whole of India. The remedying of this defect is a matter for the future, near in some cases, and rather remote, we are afraid, in some others. But we have much hope that private capital will, on the proper establishment of a gold currency in the country, be induced to supplement the official endeavours. The Government, however, might do something towards aiding the development of the mineral resources, and especially the carboniferous resources of the country.

The present output is in excess of 5,000,000 tons per annum, as compared with 3,537,000 tons in 1895, and less than 2,000,000 tons in 1889. The improvement in the decade is respectable, and would have been greater had the facilities been better. It is only in Bengal that these facilities are at all fair, and this accounts for the fact that that province takes credit at present for about three-fourths of the total for the whole country. Next in importance to it, but a long way behind, comes the Nizam's Territory, which boasts the Singareni Colliery, on the Yellandu field, where coal is estimated to be so plentiful as to be capable of supplying the needs of all the railways of India for the next 100 years. Assam, the Central Provinces, Punjaub, Central India, Burmah, Baluchistan, and other parts contribute to the annual output in fair proportion, and are each and all capable of much better things if only the disabilities were removed and communication given between the mines and the consuming centres. At present, and because the means of communication are imperfect, some districts are dependent almost entirely upon the requirements of the one particular railway which taps them. Thus, the Shahrigh, Khost, Dandot, and Bhaghanwala collieries are worked in connection with the North-Western State Railway. It would be possible, we know, to make too much of the country's future in this matter of coal, especially as the limitations on the basis of discoveries to date are quite clear. But that there is considerable room for

the growth of a great home trade will probably be allowed without much dissent.—*The Mining Journal.*

POST-OFFICE, 1900.

The Postmaster-General has just issued the 46th annual report for the year ended March 31, 1900, which contains the following statistics of the various departments of work :—

Postal Packets.—The number delivered in the United Kingdom during the year is estimated as follows :—

—	Number.	Increase per Cent.	Average number to each person.
Letters	2,246,800,000	2·7	55·3
Post-cards	400,300,000	4·7	9·8
Book packets and circulars	702,800,000	·2	17·3
Newspapers	163,400,000	6·0	4·0
Parcels (actual number)	75,448,000	4·9	1·9
Total	3,588,748,000	2·6	88·3

The number of letters registered in the United Kingdom was 16,256,852, an increase of 6·7 per cent. over the number in the previous year. Private post-cards were estimated to be about 58 per cent. of the total number now passing through the post. The increase in the number of newspapers sent was beyond recorded precedent. Those posted in London were nearly 18 per cent. more numerous than in the previous year, while not only was there a greater circulation of existing newspapers, but the number of papers placed on the register rose from 2,400 to 2,560. Of the total number of parcels delivered 64,614,000 were rail borne, while 10,834,000 did not pass over a railway. Inland parcels to the number of 838,113 were registered during the year.

The total value of property found in undelivered letters, which had to be opened in the Returned Letter Offices, was £725,613.

The articles found loose in the post have increased by nearly 80 per cent. during the last four years. Now that four ounces are carried for 1d., there is a tendency to send light articles by letter post in flimsy covers; and it would be well if the public realised the danger of the contents being lost in such cases, especially when the packets form part of mails which are transferred to or from trains in motion.

The number of postal packets posted without address during the year was 288,667. The number of parcels found in the post without address (having lost in most cases "tie-on" labels) was 14,066. In 2,767 of the unaddressed letters were found cash and bank-notes to the value of £136, and no less than £9,628 in bills, cheques, money orders, postal orders, and postage stamps.

Money Orders.—Ordinary inland money orders showed an increase of 291,582, or 3·8 per cent., in number, and £1,190,944, or 5·5 per cent., in amount, and inland telegraph orders showed an increase of 54,293, or 21 per cent., in number, and £121,014, or 13·7 per cent., in value, the total amount of the orders reaching to nearly £1,000,000. Foreign and colonial orders show an increase of 41,015, or 2·3 per cent. in number, and £21,472, or 4 per cent., in amount. There was, however, a decrease of about £125,000 in the transactions with the South African Republic and the Orange Free State on account of the war. Taking all classes of orders together, the number exceeded 12,000,000 (an increase of over 612,000, or 5·3 per cent.), while the amount exceeded £35,200,000 (an increase of over £1,922,000, or 5·7 per cent.). The number of telegraph money orders issued in this country for places abroad was 1,591, and their total amount was £7,213, while 2,183 such orders, amounting to £12,576, were received in the United Kingdom from foreign countries.

Postal Orders.—The number of postal orders issued during the year was 82,115,674, representing £28,633,884, and the produce of the commission on these orders was £343,737. The orders increased 6·98 per cent. in number, and 5·20 per cent. in amount during the year, and there was again a very large increase (17·39 per cent.) in the number of 1s. orders, which have risen in ten years from 7 per cent. to 11 per cent. of the whole.

Post Office Savings Bank.—During the year ended December 31, 1899, 14,654,609 deposits were made, the total sum deposited being £39,122,160. In the same period the withdrawals numbered 5,094,033, the total sum withdrawn being £35,171,475. The interest credited to depositors exceeded £3,000,000, and the total sum standing to their credit at the end of the year was £130,118,605. The number of depositors reached 8,000,000, or 1 in 5 of the population of the United Kingdom.

Telegraphs.—The number of telegrams sent over the wires of the department during the year was 90,415,123, the increase being 3·87 per cent. The total receipts for 1899-1900 were £2,802,366, an increase of £122,375 over those for 1898-99. During the year, 372 new telegraph offices were opened, increasing the total number to 11,188. The underground line between London and Birmingham—a cable containing 76 telegraph and telephone wires—is spoken of as practically finished, and mention is made of the fact that the use of bicycles for the delivery of telegrams has been further extended, the number at present in use in various parts of the country being 1,141. It is intended eventually to extend their use in all places where they can be advantageously employed.

Telephones.—The number of post-offices open for trunk telephone business on March 31 was 299, an increase of 13 in the year. The trunk lines in use consisted approximately of 68,657 miles of wire, and 7,250 miles of wires were in course of construction. The total number of trunk wire transactions during

the year was 8,094,578, or, reckoning each transaction as involving at least two spoken messages, a total number of 16,189,156 (an increase of 14·55 per cent. over that of the preceding year). The revenue was £191,701 (an increase of 14·44 per cent.), and the average value of each transaction was the same as in the preceding year—viz., 5·68d. The Post-office telephone and private wire system shows a general increase, the revenue for the year from this source being £148,200, as against £142,600 in the previous year. Contracts involving the expenditure of more than £500,000 have been made, and works necessary for the establishment of a Post-office exchange system in the London area are in progress.

Post-offices.—The total number of post-offices open on March 31 last was 21,940, 75 new offices being completed during the year, while the total staff of the Post-office on March 31 was 167,070, of whom 91,273 were established officers. Apart from the Army Post-office, 2,685 servants of the department were withdrawn for military service in South Africa as Reservists, Militia, Yeomanry, or Volunteers, these men's places being, however, kept open for them. The Army Post-office Corps, attached to the 24th Middlesex (Post-office) R. V. Regiment, has been increased from the peace footing of 111 to 336 with seven officers, and in addition three officers and 56 men unconnected with the regiment had been enlisted for one year or the length of the campaign. The reserve of trained telegraphists had been increased from 100 to 216 for service in South Africa, and in addition 44 skilled telegraphists and 50 linesmen were temporarily enlisted.

Finance.—The postal revenue of the year, including the value of services rendered to other departments, has been £13,394,335, an increase of £345,018 on that of the previous year. The postal expenditure has been £9,683,704, an increase of £493,698 on that of the previous year. The net profit was thus £3,710,631, or £134,199 less than last year.

The telegraph revenue of the year, £3,406,492, shows an increase of £200,347, and the telegraph expenditure £3,748,930, an increase of £266,916 upon the previous year.

The net deficit on telegraphs was thus £288,438, or £66,569 more than last year. If allowance be made for interest on the capital—£10,868,663—created for the purchase of the telegraphs, the deficit on the year is raised to £587,326.

THE RUBBER INDUSTRY OF THE AMAZON VALLEY.

Of late years the enormous consumption of rubber in the manufacture of bicycle tyres has created a very great demand. The supply not being able to cope with this demand the price has steadily increased, and considerable attention is now being paid to the production of rubber all over the world. So great is the demand at present that although the supply from the Amazon Valley alone has increased from 8,635 tons in 1880, to 25,370 tons in 1899, the approximate price of 2s. 6d. per pound in 1889 increased to 4s. 6d. per pound in 1899. The British Vice-Consul at Manàos states that the total world's supply to-day is about 120,000,000 to 130,000,000 lbs. valued at about £15,000,000. At the present time laticiferous plants yielding "caoutchouc" or "rubber" are being worked for commercial purposes in Brazil, Bolivia, Central America, East and West Africa, whence come the chief supplies, while Guiana, the Eastern Archipelago, Madagascar, India, and Ceylon contribute a small quantity to the general stock. More than half the total supply is exported from the Amazon district. In Brazil several kinds of laticiferous trees exist from which rubber is manufactured. In the State of Ceará, the *Manihot Glaziovii*, locally known as the Maniçoba, is fairly extensively worked, and considerable attention is being paid to its cultivation. In the State of Maranhao the *Hancornia speciosa* or Mangabeira, is beginning to give results. These trees, however, are unimportant compared to the *Hevea Braziliensis* or Seringueira, to which the Amazon Valley owes its present prosperity. The *Hevea Braziliensis* is found scattered through the forests that clothe the banks of the Amazon River and its tributaries. It does not strike the eye among the innumerable varieties of trees to be met with in the Amazonian forests, and is often difficult to detect. A peculiar glistening of the trifoliate leaves and the whiteness of the bark serves as a guide to the practised eye. The tree grows to the height of 70 to 100 feet, and has as a rule, when full grown, a girth of from 5 to 7 feet at a height of one yard from the ground. The tree flowers in January; the seeds are ripe and begin to fall in March in the case of old trees, and in May in the case of young trees. The seeds are contained in a hard shell, three or four in each shell, which hang by a short stalk from the upper and outer branches. When ripe the shell explodes, often with a loud report, scattering the seeds to a considerable distance. For this reason it is difficult to procure seeds. There are for practical purposes three distinct varieties of the "seringueira" to be met with in the forest. These are locally known as the seringueiras "casca vermelha" (red bark), "barriguda" (bellied), and "casca preta" (black bark). The first of these, the "casca vermelha," grows in the higher parts of the forest which are seldom or never flooded. The latex which it yields is scanty, thick, and will not run. It is therefore of little value. The second of these the "barriguda" so named because the trunk increases very rapidly in thickness towards the base, grows in those parts which are almost constantly flooded, named "igapós." It yields plentifully a thin, watery latex, which is of little value. The third variety, the "casca preta," grows in those parts where a certain amount of drainage exists, and which form an intermediary zone between the permanently

flooded parts and the high land. It is this variety which yields the latex from which the rubber of commerce is manufactured. The "latex," or as it is commonly known, the "milk" of the tree, is a milky juice contained in special tubes running amongst the other tissues of the plant. These tubes, in the case of the hevea, are connected, forming what is known as the "laticiferous system." The latex is quite different from what is called the "sap," and probably does not play any part in the nutrition of the tree. According to some authorities it forms a reserve of water to be drawn upon in cases of drought. The actual extraction of latex cannot kill the tree, and the common statement that the trees are "bled" to death is a mistake. As a matter of fact, though trees, exhausted, inasmuch as they will not yield any more latex are common—actually dead trees, killed by overtapping, are rarely met with. The latex as it exudes from the bark is of a dazzling whiteness, resembling milk, which it also resembles in composition, inasmuch as it consists of an emulsion in which "caoutchouc" takes the place of the butter in the ordinary milk. The fluid part of the latex eonsists of water with very small quantities of albuminous matter, organic acids and phosphates in solution. The extraction of the latex, or as it is usually called the "tapping" of the tree is effected by making an incision in the bark of the tree. From this incision the latex flows for about three or four hours, after that it stops flowing of its own accord. The incision should not penetrate beyond the bark, which is generally about $\frac{3}{8}$-inch thick, into the wood of the tree, and for this reason a very small axe, which rapidly thickens wedge like from the cutting edge is used, the shape of the instrument preventing its entering too deep. The axe is generally about $\frac{3}{4}$-inch wide. The custom is to strike with it a backhanded blow upwards, thus making an oblique cut in the bark. It is probable that a better method would be to use a chisel and mallet and make a **V** shaped incision. Recent experiments at Henaratgoda have shown the advantage of this shaped incision. The incision having been made, a small tin cup, of a capacity of about four ounces, is affixed just below it to receive the latex as it flows. This is effected by pressing the edge of the cup, which is sharp, into the bark, until it gets a sufficient hold to remain firm. By this method, however, a second wound is made in the bark, which is injurious. No better method has yet been suggested. In some places a winding groove is cut in the bark of the tree, and by means of a clay breastwork the milk is conducted into a vessel placed at the foot to receive it. This method is found, however, to be very exhausting to the tree, and is falling into disuse. The usual mode of tapping is to make an incision with the axe at the height of some six or seven feet from the ground; on a level with that incision and at a distance of some eight inches a second cut is made, and so on round the tree. On the next day incisions are made just below these, and so on day by day, until they reach the ground. Incisions are then made on the same plan, beginning as before from the top and working downwards between the former rows. A tree that will carry seven cups eight inches apart is considered a large one, and although trees that will carry eight or nine cups are to be met with, the average do not carry more than four or five. The latex having been obtained and collected, the caoutchouc, or rubber known to commerce, may be obtained from it in various ways. The only method, however, that has met with practical success is that of evaporation, by which the watery portion of the latex is driven off, and solid caoutchouc remains. The object to be secured is that as little water as possible shall remain in the caoutchouc, the putrefaction of the caoutchouc owing to the presence of these matters being extremely detrimental to its elastic properties, and therefore to its market value. In the Amazon district the method followed is to light a fire upon the ground, and to invert over it a specially-constructed, funnel-shaped chimney. From the narrow end of ths funnel, which is open, the smoke and heated gases pour out in concentrated form. The fuel used for the fire consists, as a rule, of chips from any hardwood tree that grows handy to the labourer's hut. The nuts of the "Urucury palm" (*Attalea excelsa*) are sometimes used, their smoke containing a trace of acetic acid, and creosote being found particularly effective in curing the rubber and preventing putrefaction. It is, however, a mistake to suppose that all or even a large proportion of the rubber coming from the Amazon district is cured in this way. It is, on the contrary, very rarely that the rubber cutter will be at the trouble to collect these nuts, he nearly always prefers to use wood chips, which give him less trouble to procure. The fire having been made, and a large stream of hot smoke pouring out of the chimney, the operator seats himself on a small stool by the side of it. The latex is contained in a basin placed at hand. In his right hand he holds a paddle-shaped piece of wood, in his left hand a small calabash. Dipping the calabash into the basin of latex he pours a small quantity over the paddle, which he then revolves in the smoke issuing from the chimney. That having dried in a layer over the paddle, he repeats the operation. In the course of time a "ball" or "biscuit" of solid rubber is thus formed. In some parts where it is the custom to manufacture very large balls or pellets, an arrangement is made by means of a pivot to rotate the ball over the chimney. The wooden core is withdrawn through a slit made in the "biscuit," or simply drawn out in the case of the pellet. The latex of a tree named "macaranduba" (*Mimusops elata*), and more often that of a tree named locally "amapa" is sometimes used to adulterate that of the *hevea*. In both cases the adulteration is extremely prejudicial to the quality of the rubber produced. Three distinct qualities of rubber are manufactured in the Amazon district, namely, "fine," "entrefine" and "sernamby" respectively. "Fine" rubber has been well smoked,

and is free from putrefaction. "Entrefine" rubber has been either burnt while being smoked, or has been insufficiently smoked, and has therefore putrified. It is due to carelessness on the part of workmen, which it should be possible to avoid. "Sernamby" is the "negro-head" of commerce, and consists of scraps mixed with dirt, or strips peeled off the bark of the tree, and mixed with impurities of all sorts.

SILK INDUSTRY OF LYONS.

The Romans established works in the third century A.D. for the manufacture of cloth of gold and silver, but every vestige of these was swept away by northern invasions. The present silk industry was brought from Italy, Spain, and the Levant about the year 1466, under the fostering care of Louis XI. He imported machinery and weavers, with the expressed purpose of diminishing the stream of gold then flowing into foreign countries. It is recorded that five ounces of silk at that time cost from £12 to £16, or from 40s. to 50s. per yard. Among the encouragements offered to silk weavers during the first century of the existence of this industry in Lyons, was exemption from military service and taxation. So rapid was its development that in 1650 the weavers numbered 18,000 or 60,000 with affiliated pursuits.

No branch of the industry was free. The Government determined the wages and hours of labour, ordained how many looms one employer should run, the number of apprentices and the term of apprenticeship, what class of goods he should make, whether a woman or a man who had married into a weaver's family should be permitted to work as a weaver, how many clerks a manufacturer should have—the whole business being involved in a code of complicated regulations, causing constant wrangling between employer and employé, and creating an army of life-tenure officials to discover breaches and to enforce regulations. These were subject to frequent changes, such as the imposition of a tax on foreign workmen, prohibition to weave in the country during a period of ten years, a graded tax upon looms, limitations of the hours of labour and of the output, the whole creating a situation in which the rights of individuals were all defined and subject to the arbitrary whim of inspectors. Complaints made by spies were followed by fines, exile, and even hanging.

Lyons is now a school for teaching the manufacture of silk, as well as a great centre of the silk trade. Young men go there from all countries to learn to make silk, acquiring the language while learning an important branch of commerce. In the silk department of the commercial school, there are generally from 250 to 300 pupils. The price of tuition is £33 per year for Frenchmen and £50 for foreigners. All kinds of silks, velvets, plain and figured goods are made by the learners under the superintendence of skilled workmen, with the most improved machinery. The municipal school, on the Croix-Rousse-hill, the traditional home of the weaver, admits only the Lyonnese youth, and is sustained by the municipality. Any boy fifteen years of age, with the residence qualifications, can learn the theory and practice of silk weaving, designing, and making patterns for 7s. 6d., the total registration fee for the three departments. The day course of study is ten months. In the night school, provided for children who are employed during the day, a course of three years' study is required before graduating. Among the 300 or 400 pupils are the children of the rich and poor, some kept there at a sacrifice on the part of their parents. Each learner is required to keep a carefully-written diary of his work, with abstracts of lectures, patterns of silk, designs of machinery, diagrams, &c. A presentation of this book to a silk dealer invariably secures a situation. Everything is taught, from the breeding of the silkworm to the weaving of the finest stuffs for wearing, upholstering, mural decoration, and artistic embroidery. The product of the school, which is sometimes defective, is sold at nominal figures.

Upon the Croix-Rousse-hill there are not less than 25,000 men and women engaged in weaving silks and velvets. Many of them have no idea how many generations their families have been working in the same rooms, but the genealogy would probably run back through several centuries. Their work represents the finest silks, satins, and velvets made in the world. The men earn an average of 2s. 6d. per day and the women 2s. A good workman engaged upon the finest material will earn 4s. to 5s. per day. A very few employed upon exceptionally fine goods, involving the use of an infinite number of colours and shades, receive as high as 10s. per day.

For a year or more, Paris and Lyonnese artists have been making designs for work to be exhibited at the Paris Exposition. One piece of tapestry contains two hundred distinct shades and tones sprinkled over the branches, buds, flowers, and leaves that compose it. Two hundred thousand cards were used on the jacquard hand loom upon which it was woven. The ingenuity of the dyer is taxed to find names for the various tints. There are satins and velvets printed on the warp, produced in the manner that a job printer employs for a coloured card or bill, each shade requiring a distinct impression, and some as many as sixty different impressions. After the warp is printed the weft is formed by from two to eight shuttles, each carrying a different colour of thread. After the silk is printed and woven, raised work is added.

Hand work is rapidly giving way to power looms, especially in the plainer fabrics. The latter can do from three to four times as much work as the former, if producing light stuffs. In making velvets and figured goods the difference will be about double. A power loom will produce some 49 yards of tulle per day, against 32 yards on a hand loom worked by a

good man. The manufacture of velvets by power looms was commenced about thirty years ago, and they have now pretty generally taken the place of hand looms. The *Weavers' Bulletin*, of February, 1900, stated that the number of hand looms in use in Lyons, December 31, 1889, was 17,294. On December 31, 1899, the number had fallen to 8,637. Between the same dates the number of power looms increased from 200 to 2,383. Thus, 8,657 hand looms had disappeared in ten years. The output undergoes a slight annual increase, as shown by the following:—1894, 379,000,000 frs.; 1895, 399,000,000 frs.; 1896, 400,000,000 frs.; 1897, 404,000,000 frs.; 1898, 415,000,000 frs.; 1899, 451,000,000 frs. This shows an increase in 1899 over 1898 of 36,000,000 frs., largely due to the increased cost of raw silk.

The estimate of the number of power and hand looms applies only to the city of Lyons, but all the silk mannfactured in France should be classed as coming from Lyons. The raw material first goes there, where it is conditioned; that is to say, a part of it is dried, and it is all weighed in the Lyons condition house. All raw silk contains more or less moisture, which buyers are naturally averse to paying for. When a bale of silk reaches the conditioning house, three hanks are taken from it and weighed wet. They are then dried and weighed again. The amount of moisture in the whole bale is thus computed, and deducted from the number of pounds that the bale weighed. The last report of the Lyons condition house marks a steady increase in the amount of silk conditioned during the past thirty years. In 1869, the receipts were 6,840,190 lb. During the next nine years the fluctuations were few, the receipts rising to 9,356,633 lb. in 1878, and continuing at 6,818,400 lb. and 11,023,000 lb. in round numbers until 1895, when the receipts rose to 14,949,139 lb., reaching 16,512,712 lb. in 1899.

The proportion of raw silk raised in France has been steadily diminishing since 1871, when it was 37 per cent. of the world's output. It fell to 18·29 per cent. in 1878, to 16·97 per cent. in 1881, and to 9 per cent. in 1899. The percentage received in the Lyons conditioning house from the different producing countries in 1899 was: Spain, 0·34; Piedmont, 1·74; Italy, 8·72; Broussa, 6·96; Syria, 5·71; Bengal, 1·7; China, 17·4; Canton, 26; Japan, 13·17; Persia, 8·32.

The reelers and producers of cocoons in France have urged the Government to put a tariff on raw silk to protect their industry. As this would give other countries, where those commodities are free of duty, an advantage over French silk manufacturers, the petitions have not been complied with. Instead, the Government has granted a premium to silkworm breeders of 2½d. per pound, and to spinners of £16 13s. per basin of French, and £14 3s. per basin of foreign cocoons. From 1892 to 1898 inclusive, the Government has paid out more than £1,400,000 in premiums for silk breeding. The quantity has steadily declined, because more money can be made from the land in the silk-growing districts by cultivating wines, fruits, and early vegetables than by raising cocoons.

Lyons silks and velvets are made in the departments of the Rhone, Isère, Loire, Ardèche, Drôme, Saone-et-Loire, Savoie, Ain, Haute-Savoie, and Puy-de-Dôme. A moderate estimate places the number of persons employed in the various industries involved in the production of silks in these departments at not less than 400,000. The secretary of the Lyonnese Manufacturers' Association places the total number of hand looms in use at 50,000, power looms 30,000. As the power loom can work more steadily, it produces considerably more than half the silk handled in the Lyons market.

Some of the hand looms that have been displaced by power have been transported from the city to the country, where they are used in the families of farmers in weather unseasonable for out-of-door work. Nearly all the velvet hand looms, once so numerous in Lyons, are now idle or in use in the country. The manufacturers and dealers have made a generous effort to aid the struggling weavers, who are suffering from the conditions involved on the introduction of steam and electricity. In 1896 a society was organised in Lyons for the development of weaving. It consisted of manufacturers and owners of buildings occupied by the hand weavers of the Croix-Rousse-hill. The founders of this society subscribed £1,250, the Chamber of Commerce of Lyons added an equal sum, and the city of Lyons met these two donations with £4,000. To the sums thus raised the Prince Imperial Buonaparte Society added £6,250 in 1856. From these donations the society has given 170 power looms to 70 weavers, who continue to live in the same quarters where their families for generations before them worked the old hand looms. The new apparatus is furnished only to men of known honesty and industry; they pay 10 per cent. of their earnings to the Society for the Development of Weaving until the loom is paid for. The electrical power costs them 2½d. per day. A man can pay for his loom in ten or twelve years. In the meantime his work will be much less laborious, his daily earnings will be somewhat increased, and when his last payment is made he has the assurance of £75 per year for each loom worked in his family.

There are sound reasons for believing that France will always possess a large silk industry, and that it will centre in Lyons. No matter how the progress of invention may lower the cost of production, the French peasantry can always make silk. Their economy and industry will be able to compete with steam. The products of their skilled labour will always find a market. France has an advantage over other nations in the creation of artistic designs. Great artists do not hesitate to make patterns for silk, for apparel and tapestry. A fine design costs from 50 to 75 per cent. less than in any other country, and the manufacturer always has a number to choose from.

The old guild records of Lyons contain many complaints of thefts of patterns by other countries, but that is largely done away with now, by the frequency of the changes of fashion.—*Textile Manufacturer.*

PULP WOOD IN CANADA.

Mr. George Johnson, statistician in the Department of Agriculture at Ottawa, has written an account of Canada's resources in paper making material which has been issued under the authority of the Canadian Commissioners for the Paris Exhibition, and some extracts from this report are taken from *The Paper Makers' Journal.*

In 1899 the United States took nearly 1,500,000 dols. of pulp wood and wood pulp. In 1881 there were five pulp mills in Canada, representing a total capital of 92,000 dols., employing 68 hands and producing an output valued at 63,000 dols. By 1891 the industry had grown to proportions indicated by the following figures:—Twenty-four mills representing 2,900,910 dols. capital, employing 1,025 hands, and producing an output valued at 1,057,810 dols. Since 1891 the increase has been still more rapid. Mr. Johnson names 36 companies now engaged in manufacturing pulp and paper, gives their post-office addresses, and mentions the kind of pulp they respectively turn out. These companies have between 15,000,000 dols. and 20,000,000 dols. capital invested. About one-third of their pulp output is sulphur fibre, two-thirds being mechanical pulp.

This development has taken place not only because it has been demonstrated that Canadian spruce is the very best quality for the purpose, but also because Canada is the possessor of the largest spruce forests in the world, and, in addition to quantity and quality of material, possesses advantages in the wide distribution of water-power and in the conditions of the labour market, all of which, combined, give her undoubted pre-eminence for the production of paper.

In Canada there is practically an unlimited supply of wood suitable for pulp of the highest character. The area of Canada upon which the spruce grows is almost conterminous with the geographical boundaries. Far east the spruce grows along the shores of Hamilton Inlet and the northern shores of the Gulf of St. Lawrence. Far north, around Ungava Bay, and far north-west in Coronation Gulf, and to the mouth of Mackenzie River, the spruce matures and arrives at good size. Far west, along the fiords of British Columbia, spruce abounds, increasing in quantity as one goes further north, and the Douglas fir, a good pulp wood standing midway between the spruce and the balsam, is widely distributed, towering 250 feet in the air, and having a basis of circumference from 30 to 50 feet.

Mr. Johnson makes calculations as to Canada's producing capacity. From an investigation made in 1894, it appeared that from 38 to 40 per cent. of Canada's area was covered with forest. That would be about 1,400,000 square miles. Taking half this area, or 450,000,000 acres, as under spruce, taking a cord as equal to 650 feet broad measure, and as capable of producing half a ton of sulphite pulp or a ton of ground pulp, and taking 7,000 feet to the acre as a fair average yield, Mr. Johnson calculates that Canada has in sight enough pulp wood to make 4,500,000,000 tons of ground pulp. This is very much below the quantity that Dr. Bell's figures would support. Dr. Bell, who is Assistant Director of the Geological Survey, has read a paper as to Canada's timber resources since Mr. Johnson's estimate was printed. In this the Assistant Director places the estimate of Canada's northern forest area at 1,657,600,000 acres, which he calculates would yield 16,500,000,000 cords of spruce.

But to follow Mr. Johnson's reckoning, the 4,500,000,000 tons of wood pulp that could be made from the timber in sight would, without any natural increase, suffice to keep the mills of the United States going at their present rate for fifty years, taking 900,000 tons of pulp wood as the quantity annually consumed in these mills. But spruce reproduces itself to pulp wood sizes once in every thirty years. Hence it is evident that the spruce forests of Canada can stand all demands upon them without fear of total deprivation in the lapse of time.

As to the kind of spruce, he remarks that as the black spruce grows on the hills and rocky ground, while the white spruce loves the valleys of the streams, and other situations where there is more soil, it follows that Canada has a much larger extent of black than of white spruce, the black being preferred by pulp manufacturers.

Following his sketch of the pulp wood resources of the country, Mr. Johnson has an account of the resources of water power, presenting tables of the various powers above and below the city of Ottawa, and briefly referring to powers in other parts of Canada. The Ottawa Board of Trade recently made an examinatiun into the resources of the region tributary to Ottawa, and found that within a radius of 50 miles there was an available water-power of nearly 900,000 horse-power, the Ottawa supplying 664,000 horse-power, and its tributaries 226,225 horse-power, those on the Ontario side contributing 40,000, and those on the Quebec side 186,225 horse-power.

With reference to the resources of the northern part of Quebec, Mr. Henry O'Sullivan, an inspector of surveys, in a recent report states that:—

"In the virgin forest, spruce, fir, tamarac, and cypress or Banksian pine are the chief conifers, while the deciduous trees are limited to poplar of different varieties, white birch, willow, alder, hazel, pembina, and similar undergrowth, with occasional black ash along the river and lake shores. There is an abundance of spruce and tamarac wherever the country has not been burned.

"Here and there areas more or less extensive have

been swept by fire from 25 to 50 years ago, and are now well grown up with poplar, white birch, spruce, tamarac, and cypress of fair size according to age, insuring an abundance of pulp wood for ages to come, and bringing down pulp as the industry of the coming age. Black spruce is the king of woods for pulp-making, and this country is the home of the black spruce."

The list of trees which flourish at James' Bay or on its drainage basin includes, according to Professor Bell, the spruce (two feet or more in diameter), Banksian pine, silver fir, arbor vitæ, elm, white pine and red pine, and of lesser importance the poplar, mountain ash, and mountain maple.

TANNING IN INDIA.

The *Indian Mechanic* says: At the present time tanning might almost be said to rank among the decadent industries of India, although it is but a few years since the prosperity of Indian tanners became quasi-proverbial. The enormous export trade in tanned skins and hides that was done by Madras a few years ago, was a trade that yielded large profits. Now, however, not only are profits reduced, but in many instances tanners have incurred heavy losses, output has been reduced, and the whole trade has lost ground. Not only this. Some 10 years ago factories were opened in Calcutta for the purpose of drying skins and hides, and the dried articles began to be largely exported to the United States of America, where they underwent the tanning processes. The reason for this was not merely that American tanning produced better leather, but also that it was both more expeditious and cheaper. More recently a "pickling" process has been resorted to in Madras in place of tanning; and pickled skins are now being exported in lieu of tanned skins. Not that shipments of the latter have been stopped entirely. The pickled article has only partially taken the place of the tanned, but unless some considerable improvements are made in the process of tanning resorted to in Southern India, it appears probable that every year will see an increased proportion of the skins and hides of the country exported in an untanned state, so that they may undergo in America or England the cheaper and more expeditious processes of tanning that are in vogue there.

Circumstances such as those briefly alluded to, lend additional interest to any practical suggestions for the improvement of local tanning or for the introduction of new tanning agents. We are led, therefore, to call attention to the latest number of the *Agricultural Ledger* (No. 9 of 1899) wherein the merits of Tari or Tari pods as a tanning agent are discussed. Hitherto Tari appears to have been regarded chiefly as a dye-producer, but in the publication under notice a report on an analysis of the pods by Professor Wyndham R. Dunstan, M.A., F.R.S., Director of the Scientific Department, Imperial Institute, London, calls attention to the valuable properties of the plant as a tanning agent. In some localities in India, the Tari pods are already used for tanning purposes, but the properties of the plant do not appear to be generally known, and its cultivation is perhaps not as extended as it should be. Professor Dunstan, after distinguishing between *Cæsalpinia digyna* (Tari or Teri) and *Cæsalpinia coriaria* (Divi-divi) remarks upon the analysis of the pod cases of the former. The pods, it may be remarked, hold two thick-shelled peas which contain oil, but very little tanning matter. The seeds are removed, the pod-case is then ground alone. It is easily powdered, and from the powder water readily dissolves the tanning constituents, furnishing a liquid which is of a light or dark brown colour, according to its strength. Professor Dunstan recently analysed three samples of Divi-divi pods, with the result that the poorest showed 19·73 per cent. of tanning matter, the best 32·79 per cent., the average about 30 per cent. When he came to analyse the powdered pod-cases of the Teri, he arrived at a percentage of over 50 per cent. of tanning matter, and in one instance (a sample from Assam) the percentage was nearly 60. Commenting on this, Professor Dunstan remarks that it is clear that the tanning value of Teri is greater than that of the South American Divi-divi. Moreover, in the case of Divi-divi the usual plan is to prepare for the use of the tanner an "extract" of the material, but the pod-cases of the Teri are so rich in tanning that the material could be used direct by the tanner without the previous preparation of an extract, "which, as is well-known, is a disadvantageous process, since it always leads to a considerable enhancement in colour." With the view of obtaining a practical opinion as to the tanning value of this Teri powder, a sample was furnished to a well-known tanning expert, who reports that he is much impressed with the results obtained. They compare very favourably with those contained by the best Divi-divi, whilst the aqueous liquor from *C. digyna* did not appear to undergo the injurious fermentation that is the difficulty in the use of *C. coriaria*. Professor Dunstan gives in tabular form the results of the analysis of three specimens of the powdered pod-cases of *C. digyna*, derived from Burma and Assam (though he erroneously refers to one of the Burma samples as from Bombay). The table is as follows:—

CÆSALPINIA DIGYNA.

I. I No.	Serial No.	Whence received.	Moisture per cent.	Tanning matter in material dried at 110 per cent.	Total soluble matter per cent.	Non-tanning matter per cent.	Ash per cent.
		Pegu Circle.					
6,921	6,258	Bombay	11·07	53·82	61·95	14·08	3·28
		Eastern Circle.					
6,372	4,887	Burma	10·93	53·86	62·83	14·86	3·76
9,293	10,795	Assam	11·40	59·89	65·80	12·73	1·84

The sample from Assam is the richest in tannin. No sample was sent from Madras, and we are not aware to what extent, if any, the plant is available in the Southern Presidency.

Mr. David Hooper, in an introduction to Professor Dunstan's report in the *Agricultural Ledger*, briefly sketches the history of Teri-pods, but makes no allusion to it as growing in Madras. The earliest samples tested were from Chittagong, where the plant was growing wild. Mr. John Tail, of Kidderpore, tanned a skin exclusively with the pods, and the process of tanning extended over four days. He remarked: — "The leather I conceive to be of a very superior quality, possessing not only an equality in softness with that tanned with Divi-divi (*Cæsalpinia coriaria*), but surpassing it in colour and appearance, and is consequently capable of being used far more extensively for tanning purposes, especially when a bright colour is required, than the Divi-divi." Some years ago, Messsrs. Cammiade Brothers, of Madras, wrote to the Reporter on Economic Products, Calcutta:— "The pods of *Cæsalpinia digyna* are said to yield leather as white as snow. If that report is correct, this tannin ought to cut out all others in Madras, provided it can be grown cheaply." Mr. Evans, Chemist of the Tanners' Laboratory, Bristol, has reported upon the pods:—

"They yield about 33 per cent. of tannic acid, which is in some measure like that of babul *Acacia arabica*) pods, which gives a cream-coloured precipitate; but this unites with gelatine in the form of a precipitate as white as driven snow, and its reactions with other chemicals give divers colours, which will make it equally attractive to the dyer. In saying this much, we can say with satisfaction as a chemist that it is almost perfect; what may be its behaviour in the tannery remains to be proved."

Enough has been said to show that the merits of Teri as a tanning agent are considerable. As to the plant itself, a report from Prome describes it as a thorny scandent shrub growing on low ground and near streams in forest without bamboo. From Toungoo we learn that the tree is never found in country that is in the least hilly, nor in country that is swampy. Its habitat *par excellence* is a level ground, either near the banks of streams or on waste land near villages, deserted village sites being favourite spots. Another report describes the leaves as, generally speaking, bearing a very close resemblance to those of the tamarind tree, while the pods are smaller, and the tree itself is seldom higher than 10 ft. The pods when ripe are roasted, and the seeds then eaten, principally by the younger portion of the population. If a large quantity be eaten in this way, it has an intoxicating effect.

It would be interesting to know if this plant grows wild in any parts of Southern India, and we trust that our present remarks will direct sufficient attention to the subject to elicit some information on this point. There is little room for doubt that the local tanning industry must gradually die out unless some special agent such as the above can be produced locally.—*The Leather Trades' Review.*

*ELECTRO CHEMISTRY IN A DYE AND PRINT WORKS.**

The action of the electric current upon dyewares and intermediate products may be brought about in several ways, of which the following are the most important:—

The action of the electric current upon the substance itself, at the ordinary temperature if a liquid, or if a solid, above its melting point.

The action of the current upon the body dissolved in some solvent. This gives the best results.

The first method does not give such good results as when dealing with inorganic substances, for it is too severe in its action, and usually resolves the compound into its elements. Certainly, intermediary products are formed, but these are so difficult to isolate that as a commercial method it is not to be recommended. Most members of the aliphatic and aromatic series in a molten state can be resolved into $CO_2 + H_2O$, &c., with the production of intermediate products such as oxalic acid and glycollic acid in the aliphatic series, and hydroquinone ethers and hydro oxy carboxylic acid in the aromatic series.

The simplest apparatus employed consists of two tubes joined together by a water-tight V joint, each leg containing a circular disc pole. The dimensions of the tube, the quantity of liquor, the strength of the current, and the amount consumed should all be known.

The nature of the products obtained by the electrolysis of organic bodies depend upon two things—

1. Whether the body is a good electrolyte or not, and if not, what bodies are used to make it so.

2. Whether the decomposition takes place in an acid or alkaline medium; totally different products being usually obtained by electrolysis in each medium.

The primary action which takes place in an electrolytic cell is an oxidising action at the positive pole and a reducing action at the negative pole, and the best results are got by adapting the process so that the products thus formed are immediately removed from the field of action. This may be done in several ways.

1. Automatically by making use of the different densities of the solutions.

2. By raising or lowering the temperature of the cell.

3. By using different electrolytes in the anode and cathode chamber.

4. By using such an electrolyte that the body

* Paper by A. E. Sunderland, read before the Society of Dyers and Colourists, at the Bradford Technical College.

formed is totally insoluble in it, and thus falls out of solution, and is unacted upon by the current.

The chief interest in the electrolysis of organic compounds centres in the behaviour of the hydrocarbon radicle, which both in the aliphatic and the aromatic series seems to be very stable.

The most important reactions are, however, the reduction of aromatic nitro bodies in alkaline solution, first to azo compounds and then to hydrazo compounds, these changes being produced in a very satisfactory manner, and he yield being equal nearly to the theoretical.

If the same electrolyte is used in the anode and cathode chambers, the electrical osmosis is very noticeable, and is one of the chief difficulties in adapting these processes on the large scale, and the results obtained tend to emphasise the law of Clausius and Hittorf, that the electric current does not overcome affinities, but that the chief reactions are produced by the primary electrolysis of the electrolyte into hydrogen and oxygen.

As regards the actual production of dyestuffs by electricity, very few results have been published, and the known cases, such as the production of methylene blues, alizarin black, &c., simply depend upon the oxidising action of the electric current in the anode cell.

Goppelsroeder, in 1886, published several results which he had obtained on a laboratory scale by the oxidation of various primary amines. He states that by the action of the electric current on aniline hydrochloride in acid solution, emeraldine and aniline black are produced, and by the electrolysis of analine salt alone a brown precipitate and red to violet colouration only is obtained.

Further results which Goppelsroeder recorded are as follows :—

With methyl aniline he obtained a blue colouration ; with diphenylamine, a violet colouration ; with salts of napthylamine, brown bodies ; with napthol, a golden yellow ; while magenta, methyl alcohol, and potassium fluoride gave Hofmann's violet.

Goppelsroeder also produced aniline from nitro benzene, and alizarin from anthraquinone.

Electricity may be applied in the dyeing process itself in two ways (1) in printing, (2) in the dye-bath.

With regard to electric printing, Goppelsroeder proceeded as follows :— A plate of lead or other suitable conducting material is used as the negative pole, and the stencil pencil or plate is used as the positive pole. Between these is fed the cloth impregnated with the various chemicals. On passing the current, decomposition of the various chemicals take place wherever the stencil plate touches, and the design is produced. As instances :—

1. If the cloth be impregnated with an acid solution of aniline salt, an aniline black figure is produced.

2. If the cloth be impregnated with potassium thiocyanate, a yellow to orange figure is produced.

Goppelsroeder also found that some dyes, such as Turkey red and indigo blue, could in the same way be discharged white by the electric current, and thus, by combination with the aniline black and canarin yellow, he could produce white, black, and yellow prints on red or blue ground.

If metallic oxides were used, the oxide was precipitated, and the cloth, on dyeing with alizarins, would show a design where the current had passed.

These results, as obtained by Goppelsroeder, are very interesting, and with the azo dyes some equally interesting results have since been obtained.

The diazo compounds are so unstable that they are decomposed by ordinary daylight. I have subjected such to the ordinary current, and find that with a current of 20 to 40 volts 5 amperes a five seconds' contact will in some cases cause the decomposition, and on developing, the print will remain undeveloped. This discharge, however, is not quick or good enough, but it can be intensified by mixing along with the diazo compound a certain amount of sodium chloride, nitrate, chlorate, or other suitable chemical, which will, on the passage of the current, liberate compounds capable of discharging the diazo compound more thoroughly.

Such reactions may be greatly extended, and by making use of the colours themselves instead of bases which contain the amido group, some very useful effects can be obtained, such as, for instance, with Rosaniline, red and dark brown patterns can be obtained; with Safranine, red and dark blue; and with Cyanole some very peculiar combinations can be obtained. Cyanole on diazotising becomes yellow, but wherever exposed to air or some oxidising agent, such as an electric current, it turns a fine peacock blue shade, and on washing the print with a phenol or soda the effect is permanent. This, along with the use of bases such as Thiotoluidines, gives some useful results. Another branch of printing by electricity, which also offers some very interesting information, is the combination of organic cases along with the use of metallic anodes, This may be made use of for the production of effects of the opposite kind to the above, and most certainly in cotton and paper printing it is worth experimenting with.

There are only two machines I have seen recommended for electrical dyeing, and these in no way offer any advantage over ordinary processes. From my own experiments I consider that a machine for this purpose should fulfil the following requirements :—

1. The poles must not be of metal, but of carbon or biscuit porcelain, which conduct by becoming saturated with the electrolyte.

2. They must be as near to one another as possible.

3. The cloth must pass between the poles in the open width.

4. The poles may be perfectly smooth, and preferably cylindrical, revolving freely.

These particulars are necessary, because in the ordinary passage of the electric current across any dye solution, the tendency of the dye is to concentrate itself around the negative pole, and not to

circulate freely in the whole dye vessel, thus there is always a great danger of unevenness.

In the finishing of goods the peculiar effect which is produced by calendering a piece in two different directions, one impression upon another, is well known. This is technically termed water-marking or moire, and is due to the irregular reflection from the surface of the material, one part of the light being totally reflected, and the other part dispersed. This effect can be introduced in several ways. One way is by displacing the warp or weft threads in an irregular manner by means of combs. Another method is by placing the chief reflecting surface below an upper gauze surface, which being free to move causes a constant change of reflections, and produces this effect in a very pretty manner. But still another method is by electricity. The new process resolves itself practically into the local application of electrolysis. A platinum plate of suitable size is connected with the positive pole of the source of current. On this conducting surface is placed some absorbent material saturated with a solution of common salt. On this pad is placed the fabric to be water-marked, and the plate engraved with the water-mark connected with the negative terminal is pressed down upon it. The salt solution is decomposed, and a facsimile of the water-mark is printed on the cloth. To produce opaque designs, the absorbent material is saturated with a solution of barium chloride, which is decomposed on passing the current.

The electrical pressing machine introduced by Schreihage may also be mentioned. By its employment it is possible to hot-press any description of fabric for any duration of time, at any required temperature, and all this in an apparatus which is perfectly clean and dry, and in an atmosphere free from superfluous waste heat and steam. An ordinary press is used, and may be operated hydraulically or by any other method. The press is identical with those in ordinary use. Press boards are provided, composed of suitable insulating material, inside which are embedded the heating wires. The ends of these wires terminate in a double plugway in front of each plate. The switch-board is mounted on wheels for convenience. It can thus be utilised for any press, or can be wheeled into a corner out of the way when not required. The fabric is placed in the press in the ordinary manner, and the current switched on. The plates become warm almost immediately, and when the current is switched off are soon cool enough to handle. The cost of the process is, I understand, not more than the present method of pressing when everything is taken into consideration.

GERMAN LITERARY PRODUCTIONS IN 1899.

According to a recent German book-trade review, the numbers of the literary productions of Germany in 1899 were as follows: — General bibliography, literary works, encyclopædias, collective works, publications of learned societies, university works, 409; theology, 2,124; legal and political science, 2,313; medical science, 1,626; natural sciences, mathematics, 1,233; philosophy, theosophy, 307; education and instruction (juvenile publications), 3,558; science of language and literature, 1,365; history, 981; geography maps, 1,358; military science, 620; trade, manufactures, inter-communication, 1,435; architecture and engineering, 720; domestic economy, agriculture, forestry, 816; polite literature (plays, popular tales), 2,931; art, 733; directories, almanacs, and annuals, 604; miscellaneous, 582; total, 23,715. The total shows a decrease of 24 in the output of 1899 compared with 1898. On the other hand there are notable increases in sections in some measure resulting from the Boer war, which has given work to medical and military men as well as to politicians and geographers, and has greatly exercised Germany.

General Notes.

THE IRONWOOD TREE.—A circular was recently forwarded to the chief Forest officers asking for information with regard to the ironwood tree of Pegu, and the result is an interesting and complete article published as a further contribution to the *Agricultural Ledger*. The tree flourishes in many provinces, particularly in Madras, Bombay, and Burma, thriving best in moist localities. It grows to an enormous height and reaches maturity in sixty or eighty years in Madras, but in the Bombay Presidency one hundred years is fixed as the commercially-exploitable age. The wood is hard, resinous and dark-coloured, and is highly appreciated in localities where it is to be had in fair abundance. It is much stronger than other woods of exceptional strength, and is so hard that a rifle shot at twenty yards distance will scarcely cause any penetration into it. It seems to be a favourite wood for scaffolding, and lasts well when kept from damp. It is also used for railway sleepers and telegraph posts. The Burma State Railway was laid with sleepers of this wood in 1877, and the majority were still good in 1894. A quantity of sleepers was sent from Burma to Madras and Calcutta in 1885-86, and the profit which accrued from the works in the Pegu Circle amounted to 36 per cent. Trees of three to four feet girth are used as house-posts and bridge piles in Pegu, and for these purposes it is said to be unequalled for its durability, while one mill in Pegu is supplying planks for paving blocks in England. The discovery of tannin in the properties of the wood, a year or two back, has imparted new interest to the wood. Mr. H. R. Proctor, of the Yorkshire College, who made the discovery, is of opinion that the new product will prove a valuable tanning material, the colour of which is fair and is a satisfactory agent.—*Indian Import and Export Trade Journal.*

Journal of the Society of Arts,

No. 2,493. Vol. XLVIII.

FRIDAY, AUGUST 31, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS FOR 1901.

The Examination Programme for 1901 will be ready in a few days, when it can be obtained on application to the Secretary. The price (post paid) is 3d.

For some time past the addition to the Examinations of an Elementary Grade has been pressed upon the Council, and they have therefore added such a grade to the system of Examinations. Particulars about it have already been published in the *Journal* (see *Journal* for the 15th June), and will be found in the Programme. The Council have also in contemplation the addition of a Higher Grade, but the arrangements for this are not complete, and no examination in it will be held in 1901.

The Elementary Examinations in Languages will be dropped, their place being taken by the new Preliminary Examinations. The Examination in Domestic Economy will also be discontinued. The practice of recommending special text-books has been abandoned, except for certain subjects where the information seems to be necessary. Certain alterations have been made in the form of the present year's Programme, which, it is hoped, will make it more convenient for reference.

The standard for the General Grade (Grade II.) will be the same as that of the existing examinations of the Society, and the regulations will generally be the same as those previously in force, except that, in addition to the certificate granted in each subject, a Certificate of Proficiency in Commercial Knowledge will be issued to any candidate who has passed in the following five subjects within a period of three years:—(1) Arithmetic (2) Book-keeping, (3) Précis-writing, (4) Shorthand, (5) a modern language.

The examination in the Preliminary Grade (Grade I.) will be adapted to the attainments of the genuine continuation school pupil who, after reaching Standards VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. There is, however, no limitation of age.

Pass Certificates will be given in each of the subjects enumerated. In addition, a certificate of Proficiency in Elementary Commercial Knowledge will be given to any candidate passing in the following four subjects within a space of three years:—(1) Handwriting and Correspondence, (2) Shorthand, (3) Elementary Book-keeping and Office Routine, (4) Commercial Arithmetic.

Every pupil, before he is given his Certificate of Proficiency, will be required to produce such evidence of general education as that he has been in Standard VI., or has through the Third year course of a Higher Elementary School, or has passed the lowest grade of the examination of the College of Preceptors or the Preliminary Local Examinations, or otherwise has reached such a standard of general education as may appear satisfactory to the Council.

Examinations will also be held in the following optional subjects:—(1) Commercial History and Geography, (2) Preliminary French, (3) Preliminary German, (4) Elements of Typewriting.

In both Grades all the subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The Fees will be:—In Grade II., as now, 2s. 6d. for each subject, and 2s. 6d. for the Certificate of Proficiency. In Grade I., 2s. for each subject, and 2s. for the Certificate of Proficiency.

The dates of the Examinations will be March 18 to 21 inclusive, 1901.

"*OWEN JONES*" *PRIZE.*

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of subscriptions to that fund, upon condition of their expending the interest

thereof in prizes to "Students of the School of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The following is a list of the successful candidates:—

Ray, John, School of Art, Battersea.—Design for a printed muslin.

Smithers, Bernard, School of Art, Battersea.—Design for a printed muslin.

Loch, Alice G., Royal College of Art, South Kensington.—Design for a damask serviette.

Sim, Mary E., School of Art, Glasgow.—Design for an Axminster rug.

Park, Robert, Kent Road School of Art, Glasgow.—Design for a printed hanging.

Cox, Thomas, School of Art, Macclesfield.—Design for a frieze in glass mosaic.

The next award will be made in 1901, when six prizes will be offered for competition.

Proceedings of the Society.

CANTOR LECTURES.

THE PHOTOGRAPHY OF COLOUR.

By E. Sanger Shepherd.

Lecture I.—Delivered March 5, 1900.

In addressing a general audience upon a technical subject such as we are dealing with in the present course, every lecturer is in danger of falling into one of two errors, either he will weary those who are well acquainted with his subject by explanations and facts they already know by heart, or on the other hand from the lack of these very explanations, a part of his audience will not be able to follow his remarks.

It is as well, therefore, to begin with first principles in so far as we know them, and to call in analogy to aid our conceptions where direct illustration may be difficult to obtain.

For these reasons I propose to recall to you this evening as briefly as possible, and in the simplest language, the principal facts of our knowledge of light and colour, laying special stress upon such points as we shall require to aid us further on and then to describe to you how lights and shadows are measured, for we must remember that however well we may understand the theory of a photographic process, it is only when we reduce that theory to actual practice in accordance with accurate measurement that we can hope to obtain perfect results. In the second lecture I shall show you how to correctly represent a coloured object as a monochrome print—work usually spoken of as orthochromatic or isochromatic photography. In the third lecture I shall show you a number of lantern slides in natural colours, explaining how they are made, and the final lecture will be devoted to colour photography in relation to the printing press.

Now think of the most striking characteristic of light. Is it not the extraordinary speed at which it travels? Think of the swiftest moving thing you are acquainted with, how long will it take to travel a mile? The racehorse "Salvator" in 1896 ran a mile in 1 minute 35½ seconds, an express railway train would travel the same distance in half the time, a shot from a 4·7 naval gun travels still faster, and the sound of the explosion would reach you a mile away in something between 5 and 6 seconds; but sound is not a material thing, only a wave or succession of waves in the air, and this is the point I wish to bring to your notice, for light also consists of waves—waves of light instead of waves of sound, and although the latter differ in many important points, they will aid us in forming a mental picture of how light travels.

During the time a wave of sound would take to travel a mile light would travel a million miles. How can you conceive such a distance? How long would it take a railway train to travel the same distance, travelling at sixty miles an hour, day and night, without stopping? Something like a year and eleven months. Now in nature we meet with wave motions of several kinds, principally distinguished from one another by the dimensions of the waves; a visible wave on the sea may be 60 feet from crest to crest (called the wave length, not as some might think, its breadth).

The invisible waves of sound are much shorter. The middle C of the pianoforte, for instance, has a wave length of about 51 inches, and the shrill shriek of a certain variety of bat, sends out waves less than one-third of an inch long, but the waves of light are all far smaller,

for the very longest waves of light visible to the eye—the red waves, are only $\frac{1}{39000}$ of an inch long, and all other colours are still smaller; as a natural result it is very difficult to demonstrate to an audience that they actually are waves. Fortunately, however, we are able to get the key to some of the laws of wave motion by watching what takes place with visible waves; for instance, ripples on the surface of a tank of water or sound waves in the air, and by analogy we can devise tests which prove the application of the same general laws in the case of the smaller waves of light.

We will commence our experiments with the motion of a wave or rather a little ripple on the

FIG. 1.

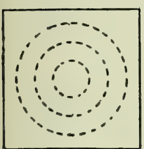


FIG. 2.

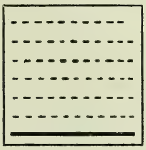


FIG. 3.

surface of a shallow tank of water. Underneath this tank of water I have a powerful electric light, which throws a shadow of the ripples on the water up on to the ground glass screen. Now if I make a disturbance in the centre of this tank by allowing a drop of water to fall on the surface, you see the ripples start out in concentric circles, following one another at regular distances (Fig. 1). If, instead of using a drop of water to create the disturbance I use a straight strip of glass, we get straight waves travelling across the tank, each little wave marching forward at right angles to its own front (Fig. 2).

Now I want you to draw a sharp distinction between the apparent motion of the waves as they spread outwards at right angles to their front, and the actual motion of the water which oscillates up and down. If I float this cork upon the surface you see that the cork moves up and down with the water as the wave passes, but is not carried forward.

Let us see what other facts we can learn from this little tank. In the older text-books we read a good deal about the rays of light: diagrams are given in which a hole is represented as cutting off a portion of the light, the portion getting through the hole appearing to travel along as a parallel beam.

Let us see what the ripple tank will tell us.

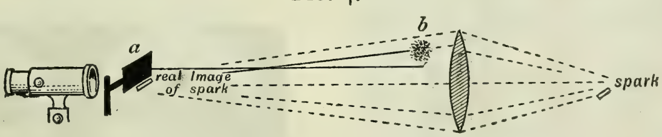
In the middle of the tank I place two strips of glass forming a barrier across the tank with the exception of a narrow gate (Fig. 3). Now if I start a ripple by dipping my finger in the water at one edge of the tank, the ripples spread out in concentric circles until they reach the barrier, the little bit of the wave front which passes through the gate does not travel on as a portion of the original front but forms a fresh centre of disturbance for a new series of wave fronts. Therefore every point of any wave front may be regarded as a source from which waves will start forward in a circle.

Now through the kindness of Professor R. W. Wood, of Madison, U.S.A., I am able to show you some very interesting photographs of actual waves of sound which will aid us very much at this point. Under ordinary conditions we cannot see a wave of sound. First of all I must tell you how these photographs were obtained.

These sound-wave photographs are not photographs of a chain of waves given out by a musical note, but of a single wave from the snap of an electric spark.

The general arrangement of the apparatus is shown in Figs. 4 and 5. B is a lens of rather long focus, the object-glass of a telescope; its diameter is 5 inches and its focal length about 6 feet. The lens is mounted in front of a suitable source of light—in the present case an electric spark—which is at such distance that its image on the other side of the lens is at a distance of about 15 feet.

FIG. 4.



The image of the spark is about two-thirds covered with a horizontal diaphragm, *a*, and immediately behind this is placed the viewing telescope or a lens to throw the image upon the photographic plate. On looking into the telescope we see the field of the lens, *b*, illuminated by the light which passes under the diaphragm, since every part of the image of the spark receives light from the whole of the lens. If the diaphragm be lowered, the field will be darkened; if it be raised, the illumination will be increased. Let us now

suppose that there is a globular mass of air in front of the lens, *a*, of slightly greater optical density than the surrounding air; the rays of light going through the upper portion of this denser mass will be bent down and will form an image of the spark below the diaphragm, allowing more light to enter the telescope from this particular part of the field. Consequently, on looking into the instrument, we shall see that the upper part of the globular mass of air is brighter than the rest of the field. The rays which traverse the lower part of B, however, will on the contrary be bent, forming an image of the spark higher up and wholly covered by the diaphragm, consequently this part of the field will appear black. It will be readily understood that with the long path between the lens and the image a very slight change in the optical density of any portion of the medium in front of the lens will be sufficient to raise or depress the image above or below the edge of the diaphragm and will consequently make itself manifest in the telescope. The sound waves (caused by the snap of the electric spark between the terminals, *a a*, Fig. 5), which are regions of condensation and consequently of greater optical density, make themselves apparent in the same way as the globular mass of air already referred to. These sound waves must be illuminated by a flash of exceedingly short duration, and this flash must occur while the wave is in the field of view. Fig. 5 shows the method used for securing illumination of the field of view and the passage of the spark which causes the wave. The spark of the small Leyden jar, *c*, passes between two thin pieces of magnesium ribbon pressed between two thin pieces of thick plate-glass, *e*; by this means, the spark is flattened out into the band and is kept always in the same plane, the light issuing in a thin sheet from between the edges of the plates. The sound waves starts from two points, *a a*, close to the lens, between the lens and the camera.

FIG. 5.

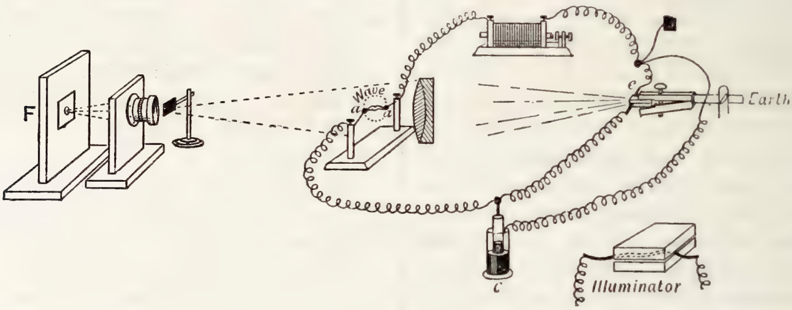


FIG. 6.

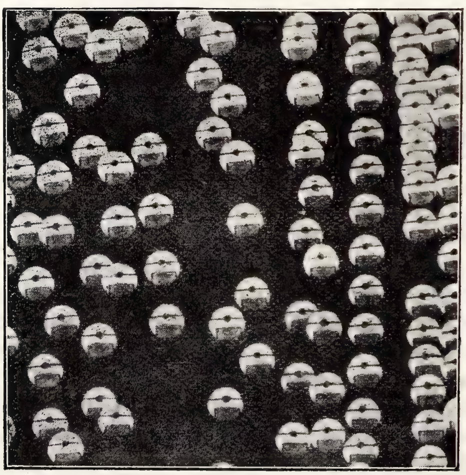
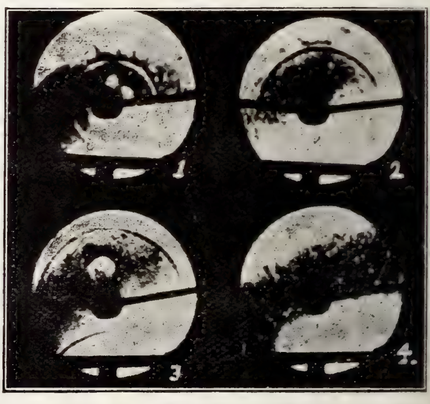


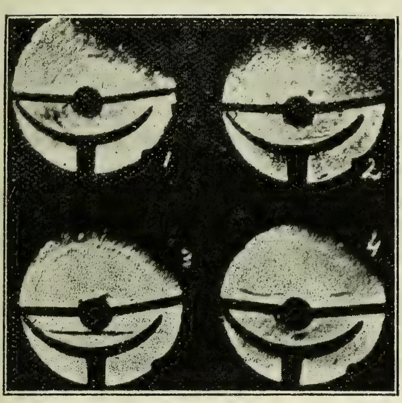
FIG. 7.



In using the apparatus a number of pictures are obtained by moving the photographic plate, at F, backwards and forwards by hand. The next slide (Fig. 6) shows us a contact print

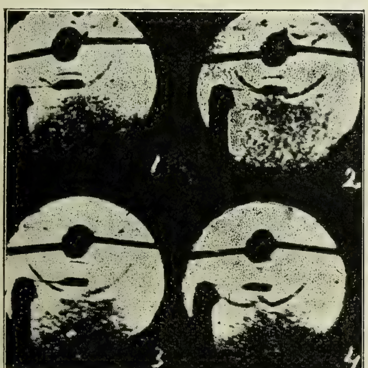
from one of the original negatives, in which the waves are seen in a number of different positions from which a set with the wave images in successive positions can easily be selected. Fig. 7 is an enlargement of a series of these little pictures, showing the reflection of the spherical wave from a flat plate. You see in the first picture the wave is spreading from

FIG. 8.



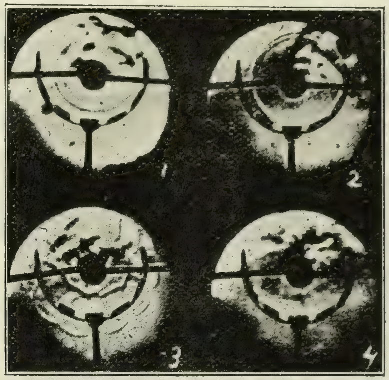
the centre of disturbance (the snap of the electric spark between the terminals A A), in the next image it has spread considerably farther, in the next we see the reflected wave, which is also a sphere with its centre of curvature below the plate. You will also note, in this picture, that a portion of the spherical wave in the path of the heated air above the

FIG. 9.



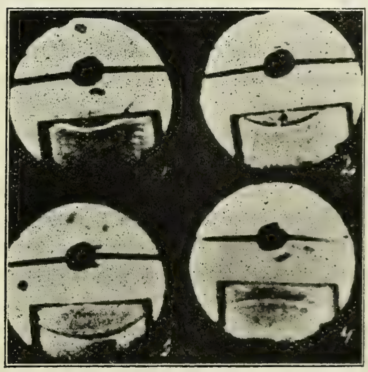
terminals has travelled a little quicker, and is in advance of the rest of the wave. In Fig. 8 the wave starts in the focus of a concave reflector, and this series shows very beautifully the action of a concave mirror on light emanating from its focus. The spherical wave strikes down into the concave reflector and the reflected wave, instead of being a sphere, as we saw it reflected from the flat plate in Fig. 7, is non-approximately a straight line. Fig. 9 shows a wave shadow. The spherical wave in the first picture of this series has just met the obstruction used to cause the shadow (a strip of glass). You see the small portion of the wave which met the flat part of the obstruction has been reflected.

FIG. 10.



In the next picture of this slide the spherica wave has travelled a little farther and also the reflected portion. In the next image the wave has proceeded still farther, and you will note how the sound is creeping behind the source of the shadow, and in the last picture we see the broken portion of the wave front re-united. The slide, Fig. 10, is of a similar subject,

FIG. 11.



but instead of one bar to cause a shadow we have a number of bars, and this slide shows very distinctly the re-union of the wave front after passing through the apertures. In Fig. 11 we have an illustration of what takes place when a sound wave passes from one medium into another of greater density. The little tanks in these four pictures

have glass slides and tops of a very thin skin of collodion. This little tank is filled with carbonic acid and is immediately under the source of the sound wave. On striking the collodion film the wave is partly reflected and partly transmitted, and it will be seen that the reflected component in air has moved farther than the transmitted component in the denser carbonic acid. This is well shown in No. 3 of this series where the wave in air, moving at a higher velocity, has passed out of the field entirely, and there only remains the slower moving disturbance in the denser gas. The last picture of these sound waves (Fig.

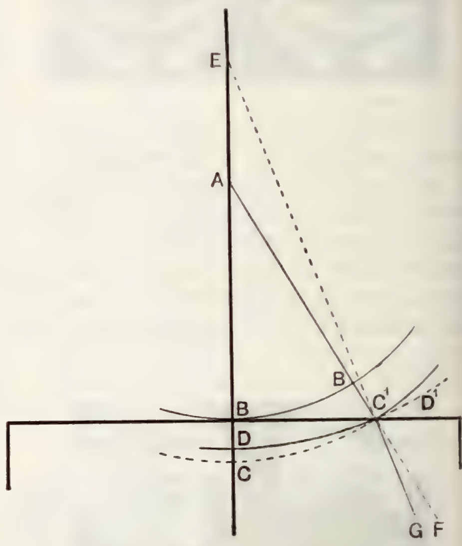
FIG. 12.

12) shows the effect of a sound wave passing through a prism of a denser medium. The prism shown in this figure has its refracting faces made of thin collodion films. In the first picture of this slide we have the spherical wave just meeting the first face of the prism. We trace it onwards until in the fourth picture of this slide we see the portion of the spherical wave has passed through the prism and the portion passed through the prism has been retarded, the dotted lines show where the wave would have arrived had it not been for the intervention of the retarding medium. This last slide illustrates a point of very great importance, viz., that a wave front passing from one medium to another of greater density is retarded or dragged back, and it is because the waves of light act in this particular in a similar way to those of sound that we are enabled to alter the line of march of light waves by the use of lenses.

A wave of light travelling through the air and entering into a denser medium, say, for instance, glass, is retarded in much the same way as that in which we saw the sound wave was when it passed into the carbonic acid. On an average—for glasses differ in density —a light wave only travels two-thirds as fast in glass as it does in air, that is to say, in the time a beam of light would travel a distance of three feet in air, it would only travel two feet in the optically denser medium, common glass.

Fig. 13 shows us what happens when light waves strike against a block of glass. Let us suppose light waves issuing from the point A are travelling in the direction B. At a certain point the front of the wave would be represented by the curve, B B′, if they were travelling on through air a short time later they would arrive at the point C C′, but as light only travels two-thirds as fast in glass as in air, by the time the ripple proceeding in the direction, A B G′, had reached G, the ripple between B and C would only have travelled

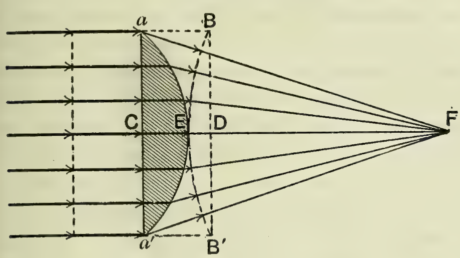
FIG. 13.



two thirds the distance, that is, from B to D. The effect of this retardation is to alter the line of march of the ripples forming a new curve, D C′. This curve is a flatter curve, having its focus one and a half times as far away, that is to say, at the point E instead of the point A. As a consequence of this alteration of the line of march, note what happens to the bit of the wave front proceeding in the direction A F. Through the flattening of the curve on entering the glass, the waves, instead of proceeding from C′ to F, are bent down, taking the new direction C′ G. This change of direction caused by the entrance into a denser medium is known by the term refraction. If we want to use this property of

refracting substances in order to bring a parallel beam of light to a focus we must so arrange matters as to imprint a curve on the face of the wave. Suppose that we have some plane waves coming along, as in Fig. 14, and we wish to bring them to a focus at F, we must place in the path of the waves a piece of glass thicker in the middle than at the sides, a plano-convex lens. Think of the moment when the plane waves arrive at the point, A C A; if they had been going on in air in a short time they would have arrived at B D B, but owing to the retarding of the waves by the denser glass the portion of the wave front marching in the line,

FIG. 14.



A E D, will only have got two-thirds as far—to the point, E, owing to the varying thickness of the glass between the centre and edges of the lens, other portions of the wave front will have arrived at the points shown by the dotted line, B E B, which forms the new wave front; this curve is concave, and the waves therefore march to a focus at F.

Let us try this experiment in the lantern. Here we have a parallel beam of light streaming out from the lantern, and here we have the plano-convex lens. When I place the convex lens in the path of the beam you see that the light is all brought to a focus: I blow a little smoke into the path of the beam, and I think you will all see distinctly what happens. The inference is, then, that all that any lens or mirror or any system of lenses or mirrors can do to a wave of light is to print a curvature upon the surface of the wave. Now each bit of the edge of this plano-convex lens is somewhat similar in form to the prism we saw in the sound-wave picture. Let us cut out the bulk of the light from our beam by means of a diaphram having a circular slit, so that the light only passes through the edge of the lens. When I blow smoke in front of the lens you see that the light coming from the semi-circular slit comes to a focus on this little screen just as it did when we used the whole lens, but let us take away this small screen and allow the light to pass on after coming to a focus, and you see that the beams cross and throw an image of the semi-circular slit up upon the large screen, but something else now attracts our attention. The image of the slit thrown upon the screen is not a semi-circular white line but is coloured. In fact it is very much like the rainbow only the order of the colours is reversed. Clearly then the wedge-shaped edge of the glass must have done something else besides imprinting a curvature upon the wave front.

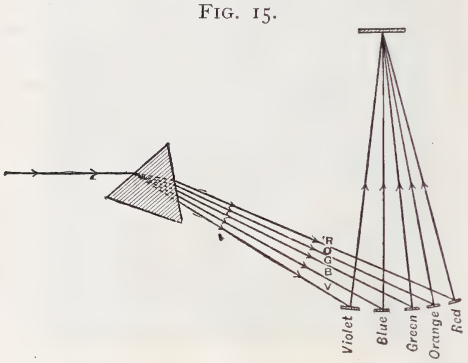
Let us look into this matter in another way. We will substitute a plain short slit for the semi-circular one in the stage of the lantern, a straight wedge of glass—a prism instead of the wedge-shaped edge of the plano-convex lens. Here we have the slit and by means of a lens we can form an image of it upon the large screen. Now in the path of the beam we place the prism and we see the beam instead of passing straight on the screen is bent away and forms an image on the small screen on my right. Not only is it bent but the component parts of white light have been bent unequally, the long red waves least and the short violet ones most. The result on the small screen is the spectrum, the key to photography in colour because it shows us the result of taking white light to pieces, and tells us that white light really consists of light of all colours mixed together.

I want to show you a few experiments with the spectrum, but as this spectrum is in an inconvenient position I will substitute another prism for this one and we get just as good a spectrum projected straight forward upon the large screen. Here are some ribbons of different colours. I take a red ribbon and a white one and pass them through the spectrum. In one position in the spectrum in the red, the red ribbon and the white ribbon appear exactly the same. I pass them on into the green and you see that the red ribbon now appears black and the white one green. I take a green ribbon and a white ribbon and put them into the green of the spectrum and you see the green and white ribbons appear to be equally bright, but in any other part of the spectrum the green ribbon appears black. I take a yellow and a white ribbon and place them in the blue of the spectrum, here the bright yellow ribbon appears black and the white ribbon blue. I pass them on into the green, and we see the yellow ribbon is no longer black because it reflects some green light and appears a shade midway between the white and black. I place it in

the red and the same thing happens. Clearly then, the yellow ribbon is sending back to the eye both green and red light. When we say then that a certain object is red, we merely mean that it reflects the red waves of light better than any others.

Now I have said that white light is made up of a mixture of all the colours of the spectrum, and if this be true, it ought to be possible to prove it by taking these separated colours or parts of white light and putting them together again. Let us try. In the path of the coloured beam proceeding from the prism, I place a number of little silvered glass mirrors. By moving these mirrors, I can throw any part of the spectrum on to this small transparent screen (see Fig. 15). If I arrange the mirrors so that

FIG. 15.



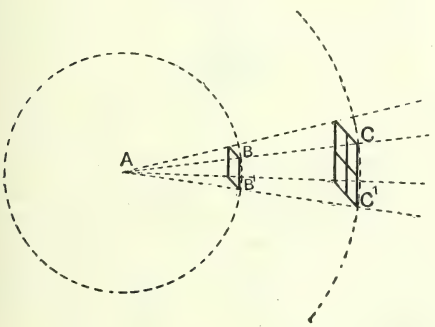
they touch one another, and each one reflects its portion of a coloured beam upon the same place on the small screen, you see all sign of colour disappears, and we have merely a white patch. We have then taken our beam of white light to pieces and put it together again.

You will have noticed that in the spectrum there are certain colours missing. For instance, there is no pink. As a matter of fact, the colours of this spectrum are nearly pure. If I take away one or two of the little reflectors used to re-combine the spectrum (Fig. 15), you see that the re-combined patch is no longer white but coloured. If I take away the little mirrors upon which the blue and violet portions of the spectrum fell, the patch of re-combined light on the screen is no longer white but yellow, proving that yellow light sends both green and red waves to the eye. If I put back the mirrors in the blue and violet, and take away the mirrors in the green, we get magenta or pink colour upon the re-combined patch. If I take away the mirrors which reflect the red and orange waves, we get greenish blue or peacock colour. A brown colour generally means a small amount of red and a still smaller amount of the other colours of the spectrum. For instance, if I use plain instead of silvered mirrors for reflecting colours on the small screen, and place a piece of ground glass in front of the green and blue beams, you see we get a dark chocolate patch on the small screen. We can then always get a colour by extracting its complementary from white light.

It is obvious from these experiments that if we can find out what parts of the spectrum are required to match any particular colour, say the colour of a piece of stained glass or of a pigment, and also measure the relative luminosity of these particular portions of the spectrum, we have an accurate description to measurement of that particular colour, but in order to do this we must have some more definite description of the part of the spectrum used than its colour conveys. If, instead of using the white hot crater of the electric arc for our radiant in the lantern, we use, for instance, the hot vapour of metal, instead of getting a continuous spectrum on the screen, as we did when we used the crater of the arc, we get a number of coloured lines. For instance, if I separate the carbon pencils of this arc light, and touch them with a strip of glass which contains sodium, we see a great deal of the colour disappears, and we get a sharp line in the yellow. If I add a little lithia and potassium to the piece of glass, and again touch the carbon pencils we get other lines in the red and the blue. These lines, which are really images of the slit, always occupy the same relative position to the spectrum, and can therefore be used as milestones or divisions of our rule by which we can accurately locate any particular part of the spectrum, and if we can find out the amount of that particular part used to make the image or in other words its luminosity, we have all the data for an accurate measurement so that we have narrowed down our inquiry into a question of finding out how we can measure lights and shadows. Let us first take a very simple case of the measurement of light and shadow. Say we want to find out which of two lights is the brighter. In the last experiment we used what is known as a standard candle. To light this lecture desk we have an ordinary incandescent electric lamp which is supposed to give a light of sixteen candles. Look at the two when placed together. To the eye the electric light looks very much less than sixteen times as bright as the candle; the fact is the eye is a very bad judge of the difference in intensity between

two widely unequal lights although it is an excellent judge of the *equality* of two closely adjacent patches of light. Our object then should be to make each light illuminate a patch on a small screen and so arrange matters that the two illuminated patches shall be close together. To do this we must have some means of varying the intensities of the illumination of the two small patches. If I hold a small square of cardboard close to the standard candle we see that it catches a good deal of light. If I take the square of card farther away it is less brightly illuminated. We can therefore alter the illumination by altering the distance, and if we can find out the rule which connects this alteration of distance with the degree of illumination, we shall have our means of measurement. To explain this matter as simply as possible, let us presume that the source of light is a point and that the light is spreading all round from this point, A (Fig. 16), at a certain point, B,

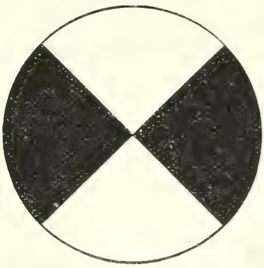
FIG. 16.



we have a white screen which catches a certain amount of the light. Now say we remove our screen to C, which is twice as far away from A as B, the light which previously fell upon BB′ now falls on CC′ and the amount of light which fell on BB′ is now spread over an area four times as great at CC′, and is therefore one quarter as bright. A square of paper then at two feet from four standard candles would be just as brightly illuminated by one candle at a distance of one foot.

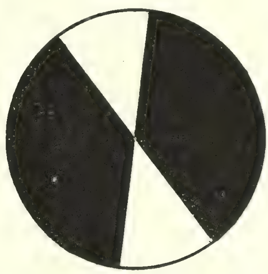
In this experiment we have presumed that light is spreading from a point. As a matter of fact, this candle flame is not a point, and would therefore introduce error, but of this I shall speak again, but it must always be remembered that the law of inverse squares will only hold good when the source of light is a very small point indeed. There is another means of altering the intensity of two lights which is often of very great value—the rotating sector method introduced by Sir William Abney. Say we had a particular light which we wanted to reduce to half its intensity. If we place in the path of the beam a sector cut ont like Fig. 17, and rotate the sector very

FIG. 17.



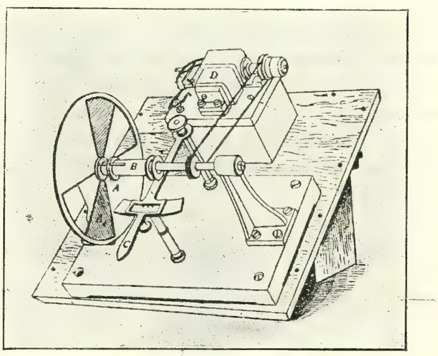
rapidly, it is obvious that the sector will cut off half the light. If we reduced the opening of the aperture of the sector, as shown in Fig. 18,

FIG. 18.



we should reduce the light to one quarter. Sir William Abney devised a particular form of sector, shown in Fig. 19, in which,

FIG. 19.

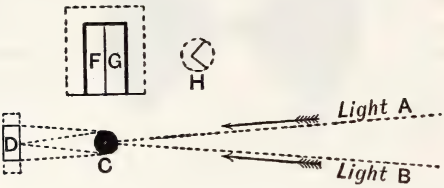


by means of a handle, the apertures of the sectors can be opened or closed whilst revolving at some thousands of revolutions per minute. We then have two means by which

we can vary the intensity of the light and these two means will be found quite sufficient for our requirements, and it only remains to consider the best means of bringing the two patches of light or shadow close together for convenient comparison.

To attain this end several different methods have been devised, but personally I find one of the simplest, that devised by Count Rumford, the most satisfactory. Fig. 20 is

FIG. 20.

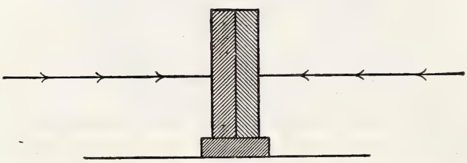


a plan of the simplest form of the Rumford photometer. The two lights A and B cast shadows of an opaque rod C upon the small white screen D. The light A shines into the shadow of the rod C cast by the light B, and the light B shines into the shadow of the rod C cast by the light A, and by varying the distance of the rod C from the screen D we can so arrange matters that the edges of the shadows exactly meet. F and G show the appearance of the two shadows upon the small screen D. We can equalise F and G either by moving the brighter light farther away, or interposing in its path the rotating sector. To secure accurate readings, scattered light in the room must be carefully avoided, even the small post, C, will scatter enough light to be a cause of error, and I have found that a piece of metal, bent like H, and blackened over a gas flame, more satisfactory than the round post.

As I said before, I have always found this form of indicator perfectly satisfactory, but there are one or two other forms which I must mention.

One is the Joly photometer, invented by Professor Joly, of Dublin, which consists of

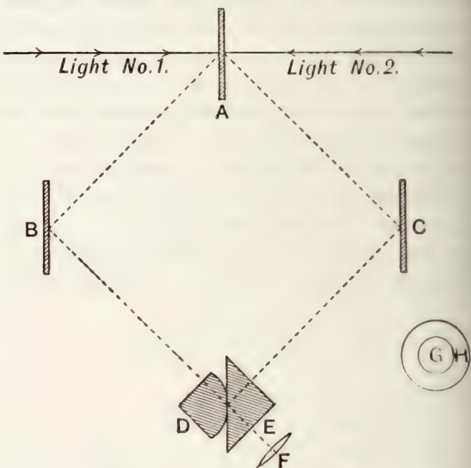
FIG. 21.



two slabs of solid paraffin wax divided by a thin opaque partition. The composite slab is set up edgewise between the two lights to be measured, and when each slab is equally illuminated, the edges of the translucent slabs appear equally bright (Fig. 21).

The other is the photometer devised by Messrs. Brodhun and Lummer, which is, however, better known by the name of the makers, Messrs. Schmidt and Hentsch, which I will now describe. The two lights to be compared shine upon the opposite sides of a white plaster disc, A (Fig. 22), and are viewed by the eye of the

FIG. 22.



observer at F, by means of the prism combination, D E, and a pair of silvered mirrors, B and C. D and E are two right-angled prisms cemented in optical contact over a portion of their surface, the side of the plaster partition A, illuminated by light No. 1, is seen directly through the sealed portion of the prism combination, and light No. 2 is seen surrounding light No. 1 by total reflection from the unsealed portion of the hypothenuse surface of the prism E, the side of the plaster disc illuminated by light No. 1 is therefore seen surrounded by the light reflected from the side of the plaster disc illuminated by light No. 2, and the equality of the two images can be determined with accuracy. The device is obviously more complicated than the Rumford photometer and taking into consideration the number of reflecting surfaces I doubt if it is really more accurate.

Miscellaneous.

MAPLE SUGAR INDUSTRY IN QUEBEC.

The United States Commercial Agent at Stanbridge says, that the maple sugar season in Quebec varies in length from ten days to three weeks, and

occurs between the 10th March and the 20th April. It is a period of exceptional activity and every available member of the family is pressed into the service, district schools being closed. Sugar "bushes" contain from 400 to 5,000 trees. Five thousand are rare, 2,000 not uncommon, but the average "bush" contains from 1,000 to 1,500 trees, which yield from one to four pounds of sugar per tree during the season. Two and a half pounds are considered an average yield, three pounds a good one, and four pounds per tree exceptionally good. Almost every farmer in eastern Quebec is a sugar manufacturer to the extent of from 500 to 15,000 pounds a year, or from one-fourth of a ton to 7½ tons. There are no available data on which to base anything like an accurate estimate of the maple sugar production of Canada, but from the facts already set forth it will be seen at once to be of considerable importance. It is of course well known that a great portion of the maple sap is never reduced to sugar, but is finished as syrup, yet the yield is always estimated in pounds of sugar, a gallon of syrup being equivalent to seven pounds of sugar. The "tapping" of 2,000 or 3,000 trees, the insertion of sprouts, and the hanging of sap buckets is very quickly accomplised by the experienced sugar makers—one man tapping from 500 to 600 trees a day. The gathering of the sap is a much more serious matter. When the "run" is on each tree has to be visited twice a day and the buckets emptied, their contents being received by a large barrel, drawn on a sled, hauled to the sugar camp, and transferred to a large tank, from which the sap is drawn off into the evaporator. From this it emerges as syrup, and if sugar is desired it is passed into another pan, where the "sugaring off" is completed. By a system of cross sections in the evaporating pan, with apertures alternating at either end, the sap is forced slowly along a zig-zag course down the whole length of the pan, from the receiving compartment, where it is thoroughly strained, to the finishing compartment, whence it is drawn off through a faucet. When the sap boils too furiously, a few drops of milk act like magic in subduing it. The skilled sugar maker can easily tell the proper consistency for syrup or sugar, but this is more accurately gauged by the hydrometer, which indicates the specific gravity of the liquid. The sugar moulds for 1½ lb. cakes consist of a few parallel wooden bars, connected by movable transverse iron sections, from which the cakes may easily be removed.

THE MINERAL RESOURCES OF THE PHILIPPINES.

According to a report on the mineral resources of the Philippines, issued by the United States Geological Survey, the coal of the Philippine islands is, so far as is definitely known, all of Tertiary age, and might be better characterised as a highly carbonised lignite. It is analogous to the Japanese coal. Lignite is widely distributed in the Archipelago, and some of the seams are of considerable width, the quality of some of them being very high. Coal exists in various provinces of the island of Luzon (Abra, Camarinos, Baton, and Sorsogon). The finest beds thus far discovered appears to be in the small island of Baton, lying to the east of the southern portion of Luzon. In the island of Zebu petroleum has been found associated with coal at Toledo, on the west coast, where a concession has been granted. It is also reported from Asturias, to the north-west of Toledo, on the same coast, and from Algeria, to the south. Natural gas is said to exist in the Zebu coal-fields. On Panay, too, oil is reported at Janinay, in the province of Iloilo, and gas is reported from the same island. Petroleum, highly charged with paraffin, is also found on Leyte, at a point about four miles from Villaba, a town on the west coast. Gold is found in a vast number of localities in the Archipelago, from Northern Luzon to Central Mindanao. In most cases the gold is detrital, and found either in existing water courses or in stream deposits, now deserted by the current. These last are called "alluviones" by the Spaniards. It is said that in Mindanao some of the gravels are in an elevated position, and adapted to hydraulic mining. There are no data available which show the value of any of the placers. They are washed by natives generally with cocoanut shells for pans, though the batea is also in use. In the province of Abra, at the northern end of Luzon, there are placers, and the gravel of the river Abra is auriferous. In Laponto there are gold quartz veins as well as gravels. Gold is obtained in the province close to the copper mines. In Benquet the gravels of the river Agno carry gold; there is also gold in the province of Bontoc in Nueva Ecija. The most important of the auriferous provinces is Camarines Norte. Here the townships of Mambulao, Paracole, and Labo are especially well known as gold-producing localities. At Paracole there are parallel quartz veins in granite, one of which is twenty feet in width, and contains a shoot in which the ore is said to assay 38 ounces of gold per ton, but this assay can hardly be said to represent an average sample. Besides the localities mentioned, many others of this province have been worked by the natives. The islands of Windoro, Catanduanes, Sibuyan, Siniar, Panay, Zebu, and Bohol are reported to contain gold, but no exact data are available, At the south end of the small island of Panaon, which is just to the south of Leyte, there are gold quartz veins, one of which has been worked to some extent. It is six feet in thickness, and has yielded from 25s. 6d. to 30s. per ton. In the island of Mindanao there are two known gold-bearing districts. One of these is in the province of Surigao, where Placer and other townships show gravels and veins. The second district is in the province of Misamis. Near the settlement of Imponan, on the Gulf of Macajalar, there are said to be many square miles of gravel, carrying large quantities of gold, with which is associated platinum. The product of this district was estimated some years since at 150 ounces per month, all extracted by

natives with bateas, or cocoanut dishes. Copper ores are reported from a great number of localities in the Philippines. They are said to occur in the following islands:—Luzon (provinces of Lepanto, Benguet, and Camarines), Mindoro, Capul, Masbate, Panay (province of Antique), and Mindanao (province of Surigao), the great island of Mindanao, being practicalle unexplored, is full of possibilities, but as yet no important copper deposit is known to exist there. An attempt was made to work the deposit in Masbate, but no success seems to have been obtained. On the other hand, Northern Luzon contains a copper region which is unquestionably valuable. The best known portion of this region lies about Mount Data. Data itself lies in the province of Lepanto. In this range, copper ore has been smelted by the natives from time immemorial, and before Magellan discovered the Philippines. The process is a complicated one, based on the same principles as the method of smelting sulpho salts of this metal in Europe and America. It consists in alternate partial roasting and reduction to "matte," and eventually to block copper. It is generally believed that this process must have been introduced from China or Japan. It is practised only by one peculiar tribe of natives, the Igorrotes, who are remarkable in many ways. Vague reports and the routes by which copper smelted by natives comes to market indicate that there are copper mines in various positions of the Cordillera Central, but the only deposits which have been examined with any care are those at Mancanyan, about five miles west of Mount Data, and two or three other districts within a few miles of Mancanyan. The deposits of Mancanyan are described as veins of rich ore reaching seven yards in width and arranged in groups. An attempt has been made by Europeans and Americans to work these deposits but with no considerable success; the failure, however, does not seem to have been due to the quantity or quality of ore found. A lead mine has been partially developed near the town of Zebu on the island of the same name. The most important deposit of argentiferous galena is said to be at Torrijos, on the small island of Marinduque. In Camarines, a province of Luzon, lead ores occur, but are worked only for the ores they contain. There is iron ore in abundance in Luzon, Carabello, Zebu, Panay, and doubtless in other islands. In Luzon it is found in the provinces of Luguna, Pampanga, and Camarines Norte, but principally in Bulacan. The finest deposits are in the last named province, near a small settlement named Camachin.

THE BRIAR ROOT INDUSTRY IN ITALY.

The wood from which briar pipes are made is the root of the large heath known in botany as the *Erica arborea*. Our "briar" is but a corruption of the French *bruyère*. The British Vice-Consul at Leghorn states that the briar root industry has had a somewhat curious history. First begun in the Pyrenees some fifty years ago, it travelled along the French Riviera and the Ligurian coast (taking Corsica by the way), to the Tuscan Maremma, and has now reached Calabria, in the south, which is at present its most flourishing centre. By the very nature of the business, when a certain district has been exhausted of all its roots, the industry must come to an end there, and the opinion has been expressed that the Italian branch of it cannot last much more than another ten years. Leghorn has always been the centre of the export of Tuscan briar root since the Maremma industry came into existence, but as the South Italian briar is of admittedly superior quality, a large quantity of the Calabrian root is also imported into Leghorn for selection and subsequent export. The total export from Leghorn is estimated at 50,000 cuts a year, valued at £28,000. Fully one half the export is Calabrian root. All the root that comes into Leghorn has already been cut on the spot into the shape in which it is exported to the pipe manufacturing centres, which are principally—at least as regards Italian briar—St. Claude in France, Nuremburg in Bavaria, and various towns in Rhenish Prussia and Thuringia. The roots, which are sometimes of a circumference of two feet or more, are cut into blocks and then boiled. If there is any defect in the root which has not been discovered before the boiling process, the blocks are bound to split sooner or later. Briar-root blocks are cut into about 25 different sizes, and three principal shapes. The shapes are "Marseillaise," "Relevé," and "Belgian." The first two are the more usual shapes; from the "Marseillaise" blocks are cut the ordinary briar pipes which have bowl and stem at right angles; "relevé" blocks are cut into a shape for converting into hanging pipes; and "Belgian" blocks, for which there is but small demand, are shaped to fashion into pipes which have bowl and stem at an obtuse angle. The minimum size of "Marseillaise" blocks is about three inches in length, two inches in depth, and one and a half inches in width. The Calabrian blocks, selected at Leghorn and exported thence, seem to be in favour with the trade, for the reason that they remain so long on the dealer's hands that they would be almost certain to split before export if they were defective. A Leghorn dealer, who does his own cutting in Calabria, has first to have the roots sent by waggon to his workshops where they are boiled and cut, thence again by waggon to the sea coast where they are placed in lighters for shipment to Leghorn. At Leghorn they are once more transferred to lighters and placed in carts for transport to the warehouses where they are unpacked for selection. They are then repacked in bales and carted to the goods station for conveyance abroad, but a considerable time must elapse before they leave the hands of a merchant who does his own cutting in Calabria. A considerable quantity of blocks is sent to the United States, but apparently none to the United Kingdom.

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FRIDAY, SEPTEMBER 7, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS FOR 1901.

The Examination Programme for 1901 is now ready, and can be obtained on application to the Secretary. The price (post paid) is 3d.

For some time past the addition to the Examinations of an Elementary Grade has been pressed upon the Council, and they have therefore added such a grade to the system of Examinations. Particulars about it have already been published in the *Journal* (see *Journal* for the 15th June), and will be found in the Programme. The Council have also in contemplation the addition of a Higher Grade, but the arrangements for this are not complete, and no examination in it will be held in 1901.

The Elementary Examinations in Languages will be dropped, their place being taken by the new Preliminary Examinations. The Examination in Domestic Economy will also be discontinued. The practice of recommending special text-books has been abandoned, except for certain subjects where the information seems to be necessary. Certain alterations have been made in the form of the present year's Programme, which, it is hoped, will make it more convenient for reference.

The standard for the General Grade (Grade II.) will be the same as that of the existing examinations of the Society, and the regulations will generally be the same as those previously in force, except that, in addition to the certificate granted in each subject, a Certificate of Proficiency in Commercial Knowledge will be issued to any candidate who has passed in the following five subjects within a period of three years:—(1) Arithmetic (2) Book-keeping, (3) Précis-writing, (4) Shorthand, (5) a modern language.

The examination in the Preliminary Grade (Grade I.) will be adapted to the attainments of the genuine continuation school pupil who, after reaching Standards VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. There is, however, no limitation of age.

Pass Certificates will be given in each of the subjects enumerated. In addition, a certificate of Proficiency in Elementary Commercial Knowledge will be given to any candidate passing in the following four subjects within a space of three years:—(1) Handwriting and Correspondence, (2) Shorthand, (3) Elementary Book-keeping and Office Routine, (4) Commercial Arithmetic.

Every pupil, before he is given his Certificate of Proficiency, will be required to produce such evidence of general education as that he has been in Standard VI., or has gone through the Third year course of a Higher Elementary School, or has passed the lowest grade of the examination of the College of Preceptors or the Preliminary Local Examinations, or otherwise has reached such a standard of general education as may appear satisfactory to the Council.

Examinations will also be held in the following optional subjects:—(1) Commercial History and Geography, (2) Preliminary French, (3) Preliminary German, (4) Elements of Typewriting.

In both Grades all the subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The Fees will be:—In Grade II., as now, 2s. 6d. for each subject, and 2s. 6d. for the Certificate of Proficiency. In Grade I., 2s. for each subject, and 2s. for the Certificate of Proficiency.

The dates of the Examinations will be March 18 to 21 inclusive, 1901.

Proceedings of the Society.

CANTOR LECTURES.

THE PHOTOGRAPHY OF COLOUR.

By E. Sanger Shepherd.

Lecture II.—Delivered March 12, 1900.

Last week we considered what light was and how it travelled. We took a beam of white light to pieces, saw that it really consisted of lights of all colours mixed together, we put the light we

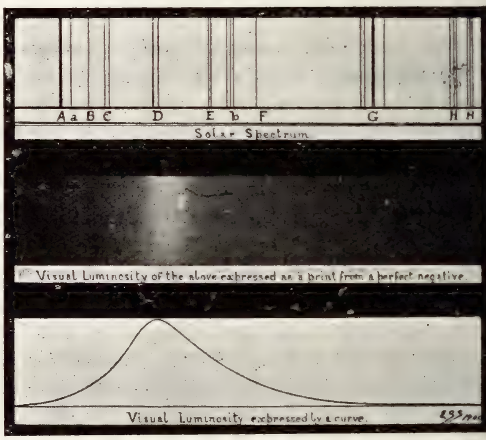
had taken apart together again and talked about how it could be measured. To-night we are to consider how very imperfectly the ordinary photograph represents a coloured object, and how this defect can be remedied.

I have here two optical lanterns. In one of the lanterns I place a natural colour photograph of some brightly coloured objects—a blue vase, a red fan, a bright blue and a yellow butterfly, some scarlet poppies and several other objects against a green cloth background — and close beside this on the screen I project a photograph of this colour slide from a negative taken upon an ordinary plate. You will see at once that the result is very unsatisfactory. The ordinary plate does not distinguish between the blue and white of the vase although the pattern on the vase is dark blue the plate translates it as white, the bright yellow butterfly, on the other hand, is represented by black; the bright scarlet poppy and the dull red of the fan are the same colour —heavy black; the detail of the butterfly's wings are missing, and the result is entirely unsatisfactory. Of course we do not hope to be able to represent in black and white the contrast of one colour with another. To actually represent colour contrasts we must necessarily have an actual photograph in colour, but in addition to the contrasts of colour in our copy we have contrasts of light and shade running all through the colours, and this scale of contrasts or relative luminosities it is quite possible to represent correctly in our photographic production.

It is clear, then, from these facts that what we have to do is to secure such photographic action upon our plates as will give us densities in our negatives directly proportional to the visual luminosities of the lights reflected from our object, ignoring altogether the colours of our object, whatever they may be.

In questions of colour it is always as well to deal first with colours in their greatest purity. Therefore let us go back to the spectrum. The spectrum as we have seen, contains all colours, so that if we can accurately reproduce its contrasts of light and shade we ought to be able to reproduce the light and shade contrasts of any natural object. In the large spectrum we now have on the screen we may note the order of luminosity. The most luminous—the brightest part of the spectrum—is in the yellow, the brightness diminishing as we pass from orange to red, on the one hand, towards the blue and violet on the other. Beneath this spectrum I now project a slide representing the luminosity of this spectrum by varying depths of light and shade—it is, in fact, a print from a perfect negative of this spectrum. Below this again is a curved line which represents these visual luminosities by the height of the curve above the base line (Fig. 23). I have prepared this illustration especially to show you what is meant when we represent the luminosity of the spectrum by a curved line. The next slide is such a curved line drawing of the luminosity of the spectrum carefully drawn to scale by Sir William Abney. Now I throw on the screen the ideal photograph of the spectrum, and below this I project a photograph of the spectrum upon the ordinary plate. You see that nearly the whole of the action has taken place in the blue, violet, and invisible ultra-violet, the action ceasing altogether in

FIG. 23.



the green. The most luminous colours of the spectrum to the eye—the greenish yellows, yellows and orange—being represented by black. The difference shown is so great that at first we wonder how an ordinary photograph can give any representation of an object worthy of the name, and it is only because nearly all natural objects reflect a considerable amount of white light that the use of photography for pictorial representation is possible. Nevertheless this want of orthochromatism or sensitiveness in accordance with luminosity is very serious in several ways. For instance, the ordinary plate does not distinguish the luminous value of a blue sky from that of a white cloud; but it is more especially when photographing close objects, notably where the colours are brilliant, that the deficiency of the ordinary plate is most felt.

How, then, are we to proceed in order to

improve our results? There are two directions in which we may work:—

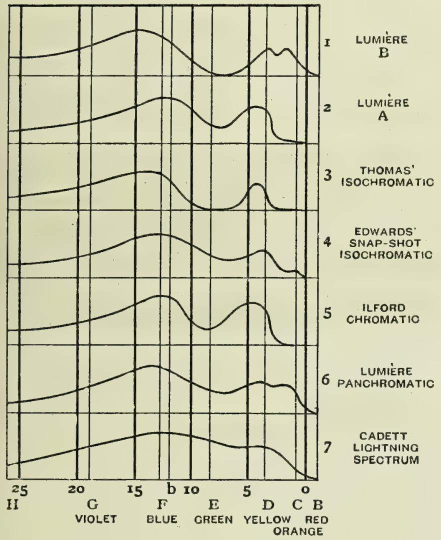
1. By so altering the constitution of the emulsion as to render it more sensitive to green and red; and

2. By filtering or screening down the action of the blue and violet so as to allow time for the red and green to impress the plate in its proper proportion.

Now nearly all photographic emulsions are sensitive to some extent to the whole of the visible spectrum, but such sensitiveness differs, as we see, very widely from the eye-luminosity of the perfect curve shown.

With regard to the first method a very great deal has been done by various investigators to improve the sensitive film. In 1873 Professor

FIG. 24.



Vogel discovered that certain aniline dyes when incorporated with an emulsion possessed the property of sensitising the resulting film to portions of the spectrum absorbed by the dye used. Not all the aniline dyes, however, possess this property of increasing sensitiveness, and much laborious experiment was necessary before plates of commercial value were obtainable.

I will now show you a number of slides from negatives of the spectrum, taken upon various brands of commercial colour-sensitive plates (Fig. 24). You will note that the best of these photographs, *i.e.*, the one nearest approaching the ideal photograph of the spectrum is the last shown, that upon the Cadett lightning spectrum plate. If, however, we compare this with the ideal curve we find it is still very far from perfect, the blue violet and the invisible ultra-violet being responsible for by far the greater portion of the photographic action, but, at the same time, the sensitiveness to green and red has been so greatly improved that by cutting down the blue and violet, by means of a light filter, it should be possible to secure, within a reasonable length of time of exposure, an accurate representation of the spectrum.

The construction of a light filter which will cut down the action of the green, blue, and violet in exactly the right proportions to secure densities upon the plate proportionate to the visual intensity is obviously a very difficult matter. We might prepare such a filter by a method of trial and error, photographing the spectrum upon the particular plate to which we wish to adjust the filter, through various colour filtering media until we found some combination which would give us the desired result. A few of the early investigators succeeded in producing light filters by this method, but the work was very wearisome, as for each trial of a filtering medium a negative of the spectrum had to be taken, and these negatives measured by means of a photometer in order to find out the amount of light passed. Only a very narrow band of the spectrum could be measured at one time, and many measurements of different parts of the spectrum were necessary for each negative before we could tell what amount of success had been obtained.

Obviously, such a method of manufacture would be of no use commercially on account of the time and material required for adjusting each filter and the cost of the necessary skilled labour. Sir William Abney's invention of his colour sensitometer has however placed in our hands a very valuable instrument indeed, only second in value to the spectroscope, and by its aid it is possible to produce light filters of very great accuracy at quite reasonable cost so that every photographer may now avail himself of their use. As we saw last week, it is a well known fact that although the eye is a very bad judge of the difference in intensity between two unequal lights or what amounts to the same thing of the amount of light transmitted by two unequal densities in a negative, it is an excellent judge of the equality of two lights or of the amount of light transmitted by two equal or nearly equal densities in a negative. Sir William Abney availed himself of this fact in the construction of the sensitometer. The general principle of the instrument is as follows:

—Suppose we take a white, a red, a yellow, a green, a blue-green and a blue glass and mount them in a row in such a manner that we can photograph them through the light filter we are adjusting (Fig. 25), we

Fig. 25.

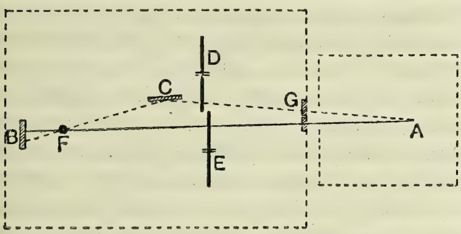
shall then have, provided the glasses are suitably chosen, a very fair representation of the spectrum, with the additional advantage that they will transmit colours which are to some extent mixed colours, and thereby the excess of one spectrum colour may be balanced by the defects of another. For instance, the yellow glass will transmit both red and green, and the blue-green glasses will transmit green and blue, and as most colours in nature are mixed colours, such a check is of great practical value. If we now set up this row of glasses, illuminating them by white light, and photograph them through the filter we are testing, the different opacities of a transparency from our negative compared with a test object will show us very approximately the amount of success attained. In order to tell with any degree of exactness, however, we must first measure accurately the luminosity of each of the coloured glasses as compared with the white glass, and then measure the amount of light passed by each of the patches of deposit in our negative. Our first necessity, then, is a means of accurately measuring the luminosity of our coloured test object—the squares of coloured glass. At first sight it would seem almost impossible to measure the brightness of a coloured patch as against a white or grey patch, but the consistency of repeated measurements convinces us that such measurement is possible. Now there are several ways in which we may measure the luminosity of a pigment or a coloured glass, and I will describe to you one or two of them.

Suppose we wish to measure the luminosity of a piece of blue paper. We might make use of the arrangement shown in Fig. 20 (*ante* p. 766). Before starting our measurements we must so adjust the position of the lights, A and B, that the two shadows of the rod, C, cast upon the screen, D, are balanced, the junction of the two shadows appearing, but as a very fine line on an even white field. We may then place the piece of coloured paper over one side of the little screen, say at F. We shall now find that the side, F, appears very considerably less bright than the side, G, we must therefore reduce the luminosity of G, and this we can do by taking the light illuminating it farther away. After the light has been removed a certain distance the degree of illumination will cause G to appear less bright than the blue paper at F which is of course receiving more light, the light illuminating it being much closer. By moving the light illuminating G backwards and forwards we shall find some place where the two patches appear to be of about the same brightness although varying in colour. Pigment papers are however not satisfactory as test objects on account of their lack of permanency and risk of alteration from dirt. We therefore require some modification which will allow us to measure the most permanent colour patches we have, *i.e.*, pot metal coloured glasses. One other point—it is very necessary that all the measurements should be made with the same quality of light as that used for testing the filters. The whitest light it is possible to obtain is that from the crater of the electric arc, and this light is therefore selected as our standard. Let me explain what I mean by the crater of the electric arc. You know that in an electric arc lamp we occasionally get quite bright violet flashes of light, this violet light would be a very serious source of inaccuracy in any series of measurements, so that it is very necessary to eliminate it. We do this by throwing an image of the arc upon a screen by means of a lens. We now have the arc upon the screen. You will note the intense white spot on the larger carbon pole and also the flaming violet colour of the arc surrounding it. If, however, we cut a hole in the screen of about half the diameter of the projected image of the white hot crater, the light that passes through the hole will be free from the violet light of the arc and the nearest approach to a white light, constant in quality, that it is possible to obtain.

There are many variations of the Rumford photometer which may be used for measuring luminosities, but I will show you the one that Mr. Cadett and myself adopted for the adjustment of filters for the Cadett spectrum plate. Fig. 26 represents the general arrangement of the apparatus. As we wished to use the crater of the arc light, and as it is very difficult to keep two electric lights of exactly the same intensity, we used only one light, A, for our work, a portion of this light reaches the screen, B, directly and another portion is reflected from the small speculum

metal mirror C to the screen B. In the path of both beams, sectors D and E are placed, F represents the rod used to cast the shadows as shown previously in Fig. 20. To use the instrument, the sector E, which is one of Sir William Abney's sectors with the apertures capable of being opened or closed whilst running, is opened to its fullest extent—180 degrees—and the sector D is then so adjusted as to exactly balance the direct and reflected beams. The piece of glass to be measured is then introduced at G, and by altering the aperture of the sector E, we may so reduce the light of this beam as to match the coloured beam in brightness. It is, of course, necessary that the whole apparatus should be carefully enclosed, so as to avoid stray light,

FIG. 26.



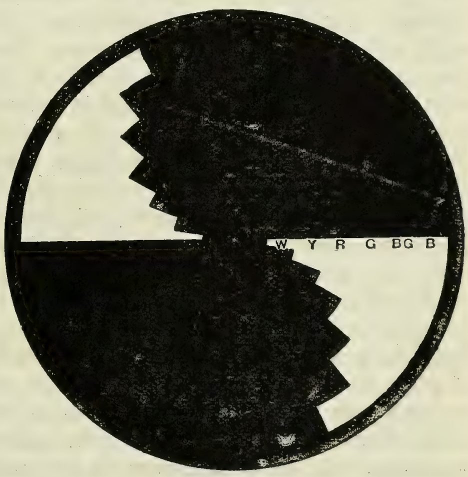
and in making comparisons we found it of great advantage to use a white plaster screen of larger area, as indicated by the dotted line in Fig. 20, when the two shadows (the coloured and the white patches) are seen surrounded by a field, the colour of which is common to both. In order that the measurements may be made with any degree of accuracy it is necessary that the sectors D and E rotate at such a speed that all flicker disappears; about 4,000 revolutions per minute are necessary to effect this, and such a speed is easily secured by means of an electro-motor driven from the mains. The apparatus is obviously of such a nature that only one operator can see this balancing of gray against a coloured light, but I can show you the principle much more satisfactorily by two lanterns. Here I have two lanterns, one of which is fitted with an objective having an iris diaphragm; in the other lantern I have placed a piece of green glass, with a mask throwing a patch of green light upon the screen. I have a similar mask in the lantern fitted with the iris diagram, and now project the white and coloured patches on to the screen side by side. As I close down the diaphragm you see that the patch of gray at one particular point is neither darker nor lighter than the green patch. In working with the photometer I have described it is impossible for one's mind to be influenced by previous readings, because the divisions of the sectors can only be read after the motor has been stopped and the sectors allowed to come to rest. To show you how consistent successive measurements are, I show you a list of a number of measurements of three coloured glasses:—

Red.		Green.		Blue.
$9\frac{8}{10}$	....	20	....	$2\frac{2}{3}$
$9\frac{8}{10}$	....	20	....	$2\frac{2}{3}$
$9\frac{8}{10}$	....	20	....	$2\frac{2}{3}$
10	....	20	....	$2\frac{1}{2}$
$9\frac{8}{10}$	....	20	....	$2\frac{2}{3}$
$9\frac{8}{10}$	....	$20\frac{1}{2}$	....	$2\frac{2}{3}$
$9\frac{8}{10}$	....	20	....	$2\frac{2}{3}$
—	....	20	....	—
—	....	21	....	—
—	....	20	....	—

White being 100.

Now, as we have measured the luminosity of each of our little squares in the test object we can easily calculate exactly how much light should pass through the density representing each patch in our test negative, but this involves making as many separate measurements of the densities as we have patches. There is, however, a simple means of avoiding

FIG. 27.



the necessity for measuring the negative at all. As we know the exact luminosity of each of the coloured test glasses it is easy to cut out a sector, having apertures proportionate to the luminosities of the test glasses (see Fig. 27), and if such a sector is revolved rapidly in front of the row of test glasses the light coming through the coloured test glasses

will be reduced to a common luminosity, that of the darkest glass of the series, and a perfect photograph of our test object taken through the revolving sector should represent each patch by a deposit of equal density. Having such a piece of apparatus set up, in order to adjust plate and filter accurately to one another it is only necessary to find out such a combination of filtering media as will enable us to secure in our negative identical densities through each of the coloured patches, and as the eye is a very excellent judge of the equality of two adjacent patches, we can tell at once by simple observation the accuracy of our light filter. We can use the photospectroscope to show us qualitatively where our filtering media cuts the spectrum, and the sensitometer to tell us the exact depth of tint of each filtering media required.

With regard to the light filter itself, in addition to its power of correcting accurately the imperfect colour rendering of the photographic plate, there are some other conditions which it must fulfil. First, it must have a fair amount of permanency and durability; and, second, it must not affect the definition of the lens. Filters could be made by filling a glass cell with a coloured liquid, but such arrangements are not satisfactory in practice, especially if we wish to use them out of doors, on account of the risk of accidental damage and leakage and the bad effect on definition caused by the circulation of the liquid with every change of temperature. For commercial purposes we are therefore restricted to a coloured film sealed in optical contact between two plates of worked glass so as to protect it from injury. For the filtering media the aniline dyes supply us with an almost endless variety of absorption, and I have had a large number of these under test under the identical conditions of the light filters, some of them for many years, and quite a number are of great permanency under the conditions stated. The permanency of a dye on a cotton fabric is of little use as an indication of its permanence in a sealed colour filter, whilst many of the dyes fugitive on cotton, silk, or wool appear to be quite permanent when sealed between glass plates. By using various combinations of these dyes in varying depths of tint it is possible to adjust a light filter to almost any curve of the spectrum. You know that in the early days of orthochromatic photography, a piece of what is known as pot metal yellow glass was used to cut down the action of the green and blue, but such glasses however, when of a sufficient depth of tint to cut down the green sufficiently to allow the red to act in its proper proportion, cut out the blue entirely, a defect almost as bad as the evil it was used to avoid, as it is quite as inaccurate to represent a blue by black as it is to represent red by black. To avoid this I introduced the plan of piercing a small hole in the centre of the yellow film, so that a small portion of white light would be mixed with a far larger proportion of the filtered light. This, however, was a clumsy device, and in the later filters has been done away with by using two or more dyed films, so that one dye would reduce the action of the green, and another dye the action of the blue. By respectively varying the depth of tint of these colour films, we can correct for definite regions of the spectrum, and it is only by means of this device that the production of filters of great accuracy has been made commercially possible. The Cadett Absolutus Light Filter has three films for adjustment, and I will now show you a number of the actual test negatives made in the course of manufacture of these filters. The components are matched up by the eye to as nearly as possible match a standard adjusted filter, but the first negative shows you what a very bad judge of a light filter the eye really is. You see that the patches instead of being all of equal density vary considerably. The fact is that the filter is cutting out what the eye does not see, which accounts for the wide variation in these first tests. The next test negative is very much better. Every patch is represented by some action, and the next negative shows a number of exposures of filters completely adjusted. Here you see that the densities are equal, and we therefore know that our light filter is correct. The filters themselves are made by coating plates of worked glass with a film of gelatine, and then, after drying, staining up the gelatine films with suitable dyes. After adjusting the depth of tint by the sensitometer, each pair of gelatine-coated plates is cut to the size of the filter required, and the two gelatine-coated surfaces sealed together in optical contact in much the same manner as the components of an achromatic lens are sealed.

When we compare the very wide difference between the curves given by the spectrum on the Cadett Lightning Spectrum Plate without a filter, with the ideal curve we see that the effect of a filter, which will so reduce the action of the blue as to allow the reds and greens to

impress the plate correctly, must of necessity considerably increase the time of exposure necessary for securing a fully exposed negative. With the Cadett Absolutus Filter exposures out-of-doors are increased about 40 times, but owing to the extreme speed of the plate, far in advance of any other sensitive surface known, the exposures are by no means prolonged, a brightly-lighted landscape requiring a fraction of a second. In the studio the relative exposures are not so widely different; about 20 times the ordinary exposure will be found about right when working under glass.

Since the Absolutus Filter was introduced a demand arose for a filter which would allow of shorter exposures, even if the result were not quite so good. We, therefore, introduced another filter called the Gilvus, which is made with all the care of the Absolutus, but the correction is made so as to represent the blues and greens strictly in accordance with their luminosity, but the reds are uncorrected, and as it is the red end of the spectrum to which the plate is least sensitive these filters only increase the exposure about four to six times. This filter has proved very valuable in landscape work and also in the studio for portraiture.

As we have seen the connection between the relative sensitiveness of the plate and the colour filter, it is obviously necessary that the manufacturer should take every care to keep this relative sensitiveness the same in different batches of plates. I do not know that hitherto any attempt has been made to secure this uniformity, and we had to devise an instrument for measuring the relative colour sensitiveness of the plates. This we did by causing the crater of the arc white light to fall upon a diffusing surface, two or three sheets of ground glass placed one behind the other about half inch apart. This uniformly white light passed through three coloured glasses, a red, a green, and a blue, and the glasses being provided with diaphragms so that by altering the aperture of the diaphragms varying amounts of red, green, and blue light would reach the sensitive plate placed some five inches behind them, the openings of the diaphragms were so adjusted that the red, the green, and the blue glasses gave patches of exactly the same density in the negative on development. All the batches of the spectrum plates are now tested with this instrument, and are far more uniform in their sensitiveness than formerly.

Now a word about the position of the filter. Provided the filter comes between the object and the plate it really does not matter much where it is placed, and we may therefore consult our own convenience. Personally, for ordinary work, I prefer the filter to be made circular and mounted in a metal cap so that it may be slipped on the hood of the lens. If the metal cap is made of thin tube this will not interfere with the use of an ordinary cap for exposure. When used in front of the lens the filter is readily seen, and we are not liable to expose ordinary plates through the filter by accident as sometimes happens when the filter is inside the camera. Where shutters are used on the front of the lens the filter must go at the back and a smaller cap can generally be contrived to slip over the back combination or screw into the mount. For the smaller size of plates it is also quite possible to use the filter close in front of the plate, and when used in this position a much cheaper quality of worked glass will be found quite efficient in practice.

When using plates sensitive to practically the whole range of the spectrum, necessarily the light of the dark room requires careful attention. The Cadett spectrum plate is least sensitive to the extreme red end of the spectrum, and therefore the light that we use should only allow this part of the spectrum to pass. By aniline dyes in gelatine it is quite possible to make a safe light, which will allow of sufficient light in the dark room to see distinctly what we are doing, so where a large lantern lighted by gas or incandescent electric lamp is available these safe lamps answer perfectly, but they are not so good for use with small lanterns, which are apt to get very hot, causing the gelatine to crack. A light less safe can be made from a combination of stained fired glasses. These are, of course, quite permanent, but will not allow of so bright a light in the dark room. If, however, the plate is kept covered during the greater part of the time, quite a bright light may be used for examination toward the end of development without injury to the negative. For the development of colour work it is best to use a developer of the quick-acting type, such as metol, for with some of the slower-acting developers, notably hydrokinone, the relative action of each colour (for instance, one of the test negatives of the Abney sensitometer) vary with different times of development. With the metol type of developer, however, the whole of the detail flashes up at once and the density of the negative may be governed by time of development.

It is a pertinent question to ask:—When

should a filter be used? In copying paintings or brightly coloured near objects, a filter of the greatest possible perfection should always be used. The Absolutus filter and the Cadett spectrum plate gives in the resulting print all luminosities exactly as seen by the eye, and experience has proved that the artist will always accept such translation as satisfactory. In landscape, however, we may with advantage use a filter less rigorously corrected with regard to the red, as in landscape a very large amount of the light, even of brightly-coloured objects, consists of reflected white light. The lighter filter will also have less effect upon atmosphere.

In conclusion, I will again place in one of these two lanterns the natural colour lantern slide, and will show you the progressive steps we have taken towards the correct rendering of this slide. Close besides the colour slide I now project, first, a slide from a negative taken upon an ordinary plate, which received 30 seconds exposure; second, a slide from a negative taken upon the Cadett spectrum plate without a light filter, with an exposure of 20 seconds; third, a slide from a negative taken upon the Cadett spectrum plate, taken through the Gilvus light filter, with an exposure of 1 min. 20 sec.; and fourth, a slide from a negative taken on the spectrum plate through the Absolutus filter with an exposure of 6 minutes.

Miscellaneous.

*TECHNICAL EDUCATION FOR INDIA.**

A technical college is usually an institution where industrial art or technique is quite subordinate to science; it illustrates the misuse of the term "Technical," which would apply far more justly to what has been dubbed an arts and crafts school. This new title, while it only expresses the same idea twice over, is an attempt to separate the industrial from the fine arts, which need no further definitions than those they already possess. Technical education means training in the art of any kind of labour whatever, and it is quite distinct from the science pertaining to that art. This cannot be too strongly insisted on, especially in India, for it points out to us the way to the industrial reformation of the country. One of the popular errors is that boys should know how to read and write before they are admitted to an industrial school. It has probably been assumed, that because in certain other countries workmen must be able to read and write, the same accomplishment is necessary in India; but we have only to refer to the history of industrial progress in Europe in order to learn that the arts of labour reached a very high development long before reading and writing became a necessary accomplishment among the industrial classes.

In agriculture the cultivator treats nature as he would treat a dealer in the bazaar, and a thousand years of experience fails to convince him that cheating is absolutely impossible. He has degraded his cotton crops until the longer staples have nearly disappeared, and instead of trying by careful choice of seed and better culture to restore the quality, he prefers to reduce the area of ground under cotton and turn his attention to other produce. In India the agricultural labourer receives the smallest pay in any grain-exporting country, and in the Western States of America the pay is highest, and yet a bushel of wheat can be grown more cheaply in the latter country than in India. It is almost needless to say that the American understands his work better than the Indian. The average acre of cotton in Egypt produces 340 lbs. of lint cotton while the corresponding figure in India is 70 lbs. The fellah is just as illiterate as the ryot, so the difference must be in the means and methods of the fellah.

Many imported articles are made by men whose day's pay would maintain the Indian for a month, and yet the latter cannot compete for the simple reason that he does not know the *art*. If he had only half the technical knowledge of the European, his situation would be greatly improved, but he is adverse to study, impatient under discipline, and, as soon as he can earn enough to meet the simple immediate needs of his family he considers his education at an end.

Had the Indian any of the energy and fertility of resource of western nations, the rivalry of foreign manufacturers would stir up in him a healthy emulation, but his only idea of competition consists in cheapening his goods, and at the same time reducing their quality—a process that leads to slow starvation.

The foreign manufacturer who produces goods in large quantities, spends considerable sums upon their design and finish, so that however inferior they may be, they have an attractive appearance. This finish has already had its effect on the Indian purchaser, who often prefers a showy foreign article to a more durable home made one. This, of course, is bad for native industry. So far has this prejudice grown that certain good articles of native make have to submit to a depreciation of price for no other reason than that they are of local manufacture. Thus the country, for the want of properly skilled artizans, is obliged to purchase from abroad large quantities of goods that, were local skill adequate, might be made from indigenous raw materials. India exports immense

* Extract from a lecture by Mr. John Wallace, C.E., Editor of the *Indian Textile Journal*, delivered at the Jamsetjee Nusserwanjee Petit Institute, Bombay, on August 4th, 1900.

quantities of materials from which paints, varnishes, leather, canvas, cordage, and other things are made, simply because the men engaged in these industries in India are not numerous enough or are not honest and capable workmen. During a recent six months Cawnpore exported 2,200,000 dried hides to Europe and to America, many of which will return in a finished state to India. Tanning, currying, staining and varnishing of leather, are done much better and more cheaply in Europe and America than here, because of the improved processes that the Indian tanners will not take the trouble to acquire.

A most interesting inquiry into the results of primary education on the children of cultivators was made by Mr. I. C. Nesfield, Director of Public Instruction in the North-West Provinces and Oudh, and published in the *Calcutta Review* for April and October, 1883. He found that primary education made the children of cultivators less contented with their lot in life, less willing to work, and more litigious. They go back to the plough with the greatest reluctance, and some positively refuse to work at first; their ambition, if they have done well at school, being to get clerical employment. Mr. Nesfield states that out of 3,024 scholars who had left school, he found 2,165 with whom he could communicate, and these he invited to be examined in the subjects in which they had received instruction. Out of these 1,037 accepted his invitation, with the result that 16 per cent. passed in one or more of the simple subjects (reading, writing, and arithmetic), and in one or other of the three more difficult grades, while the remaining 84 per cent. failed to pass in any one subject whatever.

To make a beginning a normal school must be established, and the classes would be composed of young men of not less than twenty years who have shown evidence of ability and intelligence in their trade, and while practising the operations they are intended to teach they should be exercised daily in demonstrations and descriptions of familiar processes, each student being alternately speaker and listener. In this manner they would be able to compare the descriptive power of their colleagues, and to appreciate the value of clearness and conciseness, for no technical instruction is possible unless the teacher can explain the reasons of things. The students should not be taught too much, but they should know their duties very thoroughly, and be able to impart what they know without the aid of writing. They will thus be content to work for a wage not exceeding the highest rate in their trade, and should they tire of teaching and revert to the workshop, either as journeymen or foremen, they would still be teachers and workers in the interests of technical education.

This project of technical education is presented as a first measure of reform in a matter of national importance. It is made as cheap as possible, because no costly scheme of such magnitude could be undertaken at the present time. It is simple, because it applies to a very ignorant class with a mental constitution that can only take in a very limited amount of instruction per generation, and it is non-literate, because the bulk of these people cannot assimilate technical and literary instruction together satisfactory. Besides, the technical instruction pays better than the other, and is much more easily assimilated. A time will come when the Indian workman must be able to read and write, like the European, but these accomplishments would not save the industries that are at present declining before the invasion of foreign-made goods. They have rather the effect of detaching the Indian boy from handicraft and sending him to swell the already overcrowded ranks of office clerks, whose pay is often less than that of dock labourers, and whose imperfect education precludes all hopes of advancement. It is worthy of note that the only existing institutions in which the influence of technical education can be clearly traced in India are the railway and other engineering factories under the direction of Europeans, and the textile mills. The railway workshops take the leading position, both for the magnitude of their operations and for the permanent character of the employment they offer, but they do not train enough of good men for their own requirements, and they have none to spare for the country at large. The same may be said of all the other well managed factories, so that, generally speaking, their influence and resources are not sufficient to provide the educational influence that is now required.

THE WINE INDUSTRY IN CHILE.

The vine has been cultivated in Chile for a long time; it was introduced by the Spaniards immediately after their arrival in that country, but Chilean viticulture had not assumed any real importance until thirty years ago, coincident with the introduction of the French plants and modern means of cultivation. From its climate, its soil, and its topographical configuration Chile presents the most favourable and natural conditions for the vine-growing industry, and it is destined to be a great producer of excellent wines of all classes. The vine-growing district extends from the extreme north to latitude 39 south. It is to be found located principally in the valleys, plains, and hills of the maritime zone of the south central region. H.M. Consul-General at Valparaiso says in his last report that there are in Chile two very diverse regions for vine growing—viz., the irrigated vineyards and the vines on dry or unirrigated lands. The former are found on the plains and valleys of the north and central regions; the second occupy the slopes, hillocks, and low hills of the zone on the coast of the central southern region. Also in the last-named region vineyards are to be found unirrigated in the plains and valleys. In each region one can distinguish the old or original

vineyards composed of the Spanish vines, and the modern French vineyards composed of the vines from Burgundy and Bordeaux. The watered or so-called French vineyards are cultivated on lines of palisades over wires sustained by posts of wood which is usually the Chilean cypress. The rows of vines are divided one from the other by from 5 feet to $6\frac{1}{2}$ feet, and the distance between the roots on the line is from $3\frac{1}{4}$ feet to 4 feet; there are usually two or three rows of wire to sustain the vines. These vines undergo extensive pruning. The Guyot simple pruning is mostly used, but there are vineyards submitted to the double Guyot pruning. The old vineyards of the watered regions consist of vines trained on tall overhead frameworks from 6 feet to $6\frac{1}{2}$ feet high, and are planted in squares at a distance of from $6\frac{1}{2}$ feet to 8 feet. The vineyards of the dry grounds, old and modern, whether on the plains or on slopes and hillocks, are composed of low vines without support planted in squares at a distance of from $6\frac{1}{2}$ feet to 8 feet. The height of the stems reaches from $1\frac{1}{2}$ feet to $2\frac{1}{2}$ feet. The old vineyards are composed of Spanish vines, the principal being the black grape called the native, or in Spanish the "Calona." There are also the "Jami Listan," the "Corazon de Buey," the "Viña de Gaelo," white, red, and black muscatels. The modern vineyards are planted with vines from Burgundy, black Pinot, grey Pinot, white Pinot, white and black Garnet. Roman, &c., and with Bordeaux vines, such as Cabernet, Sovignon, Cabernet-francocot-rouge, Berdean, Merlet, white Sovignon, white Loca, &c., and the Chasselas also is used. The modern or French vineyards are generally very well cultivated, the care taken with the soil and with the vines leaves nothing to be desired. From this point of view they will bear comparison with the best vineyards of Europe. The harvest is as follow:—(*a*) Irrigated vineyards.—From 60 to 100 hectolitres of wine are harvested from each hectare (from 528 gallons to 880 gallons per acre). The modern vines produce more than the old vines. (*b*) Vines on unirrigated lands.—The average production amounts to 30 or 40 hectolitres per hectare (264 gallons or 352 gallons per acre). The average of the annual production for the whole of Chile is estimated at from 2,000,000 to 3,000,000 hectolitres of wine (44,000,000 to 66,000,000 gallons). Wine-making is only carried on by the vineyard proprietors in the special buildings owned by each vineyard. The wine-making industry which has as its basis the buying of the grapes from the vine growers has not yet been introduced into Chile. During the last few years there have been constructed in the greater part of the modern vineyards special buildings for making and maturing wines. These edifices, which are sometimes very elaborate, represent a considerable capital, and burden the property, and also increase the cost price of the product. The vintage takes place during March and April. The form of the buildings, the utensils and special apparatus, the earthenware distillers, and the methods that are in use on the modern vineyards are the same, more or less, as in Bordeaux. In the last few years, new scientific systems for making wines have been introduced with excellent results, nevertheless the production of wine has not yet reached in Chile the degree of perfection that is found in the best wine production of the present time. The principal types of wine made in this country, are—Table wines, white and red, similar to those of Bordeaux and Burgundy. From the native grape is made a kind of light red wine, called "mosto," and also a wine imitating port. Furthermore, there is made from the same grape, a fermented wine, called "chicha," which is the popular wine of the country. The care and maturing of the wines are the same as in Bordeaux. The commonest wines are consumed in the country. The finer wines are matured in the warehouses for three or four years, and are sold in bottles generally by the owner of the vineyard, and with his special trade-mark. Up to the present, almost the whole of the Chilean wines have been consumed in the country, but in a short time, when the new vineyards, recently planted, reach their maximum production, Chile will it is said become an important exporter. Several attempts to export Chilean wines have been recently made, especially to Germany, France, England, United States, Brazil, Argentine Republic, and the Pacific Coast. During the last 15 or 20 years, Chilean wines have been prominent in the principal Exhibitions of Europe and North America, and in all those Exhibitions they have obtained prizes. Whenever the Chilean wines have been displayed in the principal Exhibitions of Europe and North America, and in all countries where Chilean wines have been represented, they have been found to be of excellent quality; and if the current of exportation has not yet been established, it is principally due to the high price of the article in Chile, and to the lack of cheap transport. At present the ordinary wines are sold at prices varying from 6d. to 11d. per gallon. The value of the buildings for wine making, with utensils, apparatus, large earthenware jars, &c., reaches a sum more or less equal to the corresponding value of the vineyard. This circumstance, added to the fact that the wine industry is not divided into the branches of "growers" and "makers," adds to the expense of production, whereas, in a country so privileged as Chile, it should be made in a much more economical way. The pitchers of aguardiente, or brandy, and wines of superior quality that are obtained in Chile amount annually to 1,100 gallons of 50 per cent. strength. This liquor is consumed in the country. From the muscatel grapes is made a kind of special aquardiente called "Pisco," that has the taste and bouquet of the muscatel. "Pisco" is much prized as a liqueur of the finest quality, and should repay, says the Consul-General, its introduction into the British Empire. It is specially appreciated in the north of Chile, the mining region where it has the largest consumption. In the Huasco and Elgin valleys the muscatel grape of Alexandria dries itself and produces most excellent raisins.

THE RUBBER INDUSTRY OF SIERRA LEONE.

The Kewattia, or rubber tree of West Africa, is one of the most beautiful trees of the forest, growing usually to the height of from 40 feet to 60 feet. Its leaves are from four to nine inches in length by from one to three inches in width, oblong and tapering towards the ends supported by a stem from eight to nine inches long. There are several species of vines which yield a grade of rubber inferior in some respects to that obtained from the tree; however, when gathered with care this commands a ready sale. The United States Consul in Sierra Leone says that the supply of Freetown Market for the most part comes from the hinterlands of Sierra Leone and from the Foutah country in the French protectorate farther in the interior. That which comes from the Foutah territory is limited, owing to the export tax of about three-half-pence per pound placed by the French upon all rubber sold by natives outside of their protectorate. Notwithstanding this prohibitory restriction upon the native rubber vendors, there are several regular traders who furnish to the market a good quantity of Foutah rubber every season. This rubber is almost invariably adulterated with clay, yet it grades well in the local market, and brings a good price. In former years Freetown was a better depôt for rubber than at present, but since the establishment of the French protectorate which controls the output of the valleys of the adjacent northern rivers, the trade has been directed to the French port of Konakry, 72 miles distant from Freetown. The dry period from November until May is the gathering season. Native chiefs supervise and control the sale of the output of their respective territories. The method of gathering the sap is very simple. The body of the tree is tapped and the juice flows until it is exhausted; later, new incisions are made. The juice is usually caught in cups or calabashes attached to the tree, so as to prevent impurities appearing in the rubber. The neglect of this precaution is responsible for a percentage of the incidental adulterations of otherwise good rubber, frequently found in the local market. The native in his efforts to increase his stock frequently bleeds the roots as well as the body of the tree; this is fatal to the tree. The product is known as "root rubber," and besides containing large quantities of impurities, is very inferior to any grade of tree rubber, and would be refused altogether by local buyers, in order to discourage the destruction of the forests, were it not for the sharp competition for export trade. The rubber is brought to market overland by caravans of natives, or most frequently by canoes. These cargoes are generally consigned to some particular agent, though they are often sold to the one making the best offer. For convenience, rubber is arranged in three classes or grades, known as No. 1, No. 2, and No. 3, the character of the tissue and freedom from impurities being the determining factors, as well as the kind of adulterants. Considerable ability on the part of the agent is necessary to enable him to properly assort and select the rubber and to detect adulterations. There are two classes of these—incidental and intentional. The former is the result of carelessness on the part of the gatherers who do not use proper receptacles for the juice. Intentional adulterations are due to efforts to increase volume and weight by use of dirt, sand, bark, and sometimes stones. Another species of fraud is the mixture of other non-elastic gummy substances with pure juice; still another is to soak rubber by placing it in pits close to the water for a long time. Rubber so treated is seriously injured in quality, and at the same time increased in bulk and weight. The colonial authorities as well as the chambers of commerce are endeavouring, by proper instructions to those concerned, to discourage these abuses, and to emphasise in every way possible the importance of improving the quality of the rubber brought to Freetown market. There is being inaugurated by the Governor and officials a plan to foster the planting of rubber trees and vines in the colony. To this end they have caused to be issued pamphlets of instructions in regard to seedings, transplanting, &c., through the Departments of Agriculture and Horticulture. It is hoped that there will be a decided improvement in the quality and quantity of the exports in the near future. The value of the rubber exported from Sierra Leone in 1898 was about £51,000, of which the amount shipped to Germany was £6,700. The remainder went to England.

SIBERIAN COAL.

Coal is met with in abundance in almost every direction in Siberia, west and east as well as along the Trans-Siberian Railway itself, of poor quality however, and so far comparatively little worked. The British Commercial Agent in Russia states that the beds of the Ekibastuz, Sudjenka, and Kuznetz region could supply both Siberia and the Ural, so much in need of fuel, with tens of millions of pouds annually (the Russian poud = 36 lbs. avoirdupois). Its inferior quality, of use however to metallurgical works, would be somewhat compensated by its cheapness and accessibility. Coal exists in the Kuznetz, the Ekibastuz, the Kirghis Steppes, the Akmolinsk and Semipolatinsk territories, the latter remarkably rich in reserves, in Eastern Siberia from the Yenisei, Krasnoyarsk, and Irkutch districts, along the Lena to the Far East, as well as in the Island of Sakhalin, while even along the main line near the stations of Sudjenka, Tcheremkhovo, and Misovoi, seams of more than average quality have been discovered. The Ekibastuz beds especially, in the neighbourhood of Pavlodar, on the Irtish, flowing to the railway from the south, have an almost unlimited reserve estimated to contain a supply capacity of some 200,000,000,000 pouds (3,214,000,000 tons), though the quality is anything but first rate. However moderate

the quality, the supplies then are simply unlimited, but insufficiently and even primitively worked as yet, capital and far larger enterprise being needed to fully develop them; but with the increasing communications and growing necessities they are now attracting widespread attention, as on this fuel question largely depends the future of the railway, mineral, metallurgic, and, indeed, of all the industries of Siberia generally.

Obituary.

Sir John Bennet Lawes, Bart., F.R.S.—Sir John Lawes, the distinguished Agriculturist, died on Friday, August 31st, after a short illness. He was born at Rothamsted, Herts, December 28th, 1814, and succeeded to his estate there on the death of his father in 1822. He was educated at Eton and Brasenose College, Oxford. On leaving the University he spent some time in London for the purpose of studying in a practical manner the science of chemistry. In 1834, on taking possession of his property, he started regular experiments in agricultural chemistry, and from that date to the present series of experiments of the highest importance have been continued there. In 1843 Dr. (now Sir) J. Henry Gilbert became associated with Mr. Lawes, and the foundation of the Rothamsted Agricultural Experiment Station dates from that year. Mr. Lawes read a paper on December 21st, 1853, before the Society of Arts, on "Fish Manure as a Substitute for Guano," and on March 7th, 1855, another paper on the "Sewage of London." Two and twenty years later he read a paper on "Freedom in the growth and sale of the crops of the Farm, considered in relation to the interests of the Landowner and the Tenant Farmer," and for this he received the Society's Silver Medal. In 1893 the Albert Medal was awarded to Sir John Lawes and Sir Henry Gilbert "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted," and on the 23rd February, 1894, H.R.H. the Prince of Wales, at Marlborough-house, presented the Albert Medal to Sir John Lawes, and a like medal to Sir Henry Gilbert.

Mr. Lawes was elected a Member of the Royal Agricultural Society in 1846, a Fellow of the Royal Society in 1854, and a Member of the Society of Arts in the same year. In 1867, he was awarded the Royal Medal of the Royal Society—jointly with Dr. Gilbert. He obtained the honorary degree of LL.D. from the University of Edinburgh in 1877, and that of D.Sc. from the University of Cambridge in 1894. He was created a baronet in 1882. A public testimonial was presented to Mr. Lawes in 1854, which, at his suggestion, took the form of a well-built laboratory; here, in July, 1893, the jubilee of the Rothamsted experiments was celebrated. A granite memorial, facing Harpenden-common, was erected, and a portrait of Sir John Lawes, by Mr. Herkomer, R.A., was presented to him. By a trust deed, executed in 1889, Sir John Lawes set apart £100,000, together with the laboratory and certain acres of land, for the prosecution of the investigations in perpetuity. The writer of the obituary in *The Times*, summing up the results of the life-long labours of Sir John Lawes, says that he was one of the greatest benefactors to agriculture—perhaps the greatest—the world has seen.

Sir Saul Samuel, Bart., K.C.M.G., C.B.—Sir Saul Samuel, late Agent-General for the Colony of New South Wales, died on Wednesday, August 29th, at his house in South Kensington. He was born in London, November 2nd, 1820, and sailed for New South Wales in 1832; there he completed his education at the Sydney College, and served his commercial apprenticeship as a young man in the offices of his uncles, who were English and Australian merchants. He made his first independent start in life as a squatter in the western district of New South Wales. He commenced his public career in 1854, when he was first elected a member of the Legislative Council of New South Wales, and he entered the Ministry in 1859 as Colonial Treasurer or Minister of Finance and Trade; subsequently holding the office of Postmaster-General. In 1880 he was appointed Agent-General for the colony in London, and he held this office until his resignation in 1898. He had previously been absent from his post for a year on leave, mainly on account of his failing health. He was created C.M.G. in 1874, K.C.M.G. in 1882 C.B. in 1886, and a Baronet in 1898. Sir Saul Samuel was elected a member of the Society of Arts in 1884, and he was a frequent attendant at the evening meetings, taking the chair on several occasions; he was a member of the Council 1886-87, 1891-92, and a Vice-President from 1893 to 1898.

General Notes.

Belgian Leather Industry.—*La Bourse aux Cuirs* gives a *résumé* of the Belgian leather industry for the past year, and states that the imports of raw skins amounted to some 115,000,000 lbs., as against 95,000,000 lbs. in round numbers for the year preceding. The exports of tanned skins increased from 6,000,000 lbs. to 9,000,000 lbs., and had a value of about $3,500,000. The value of the exports of leather and manufactures of leather increased from $138,200 in 1898 to $612,200 last year. The greatest improvement is manifest in the exports of glove leathers. They have increased from $240,000 in 1888 to $2,692,600 in the last fiscal period. The total value of the exportation of leather and manufactures of leather amounted to $6,921,400.

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FRIDAY, SEPTEMBER 14, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in Prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1901, when six prizes will be offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

Proceedings of the Society.

CANTOR LECTURES.

THE PHOTOGRAPHY OF COLOUR.

By E. Sanger Shepherd.

Lecture III.—Delivered March 19, 1900.

Last week we considered how we could best represent a coloured object in a monochrome print. To-night we are to advance another step, and see how we can reproduce by photography the actual colours of the object photographed. Ever since the first discovery of photography investigators have been working at this problem, but it is only within quite recent times that any noteworthy amount of success has been atttained. Attempts have been made to prepare a sensitive surface which should reproduce the colours direct in the camera, but so far all attempts of this kind have been unsuccessful, and the only methods of photography in colours practically available at the present day may be classed under two heads—(1) the interference method of Professor Lippmann, who, a few years ago, showed in this room some beautiful specimens by his process, and (2) processes based upon what is known as the Young-Helmholtz theory of trichromatic vision.

Now the first method mentioned—Professor Lippmann's—although of very great scientific interest, is at present very uncertain in its results, and as these pictures cannot be reproduced, and can only be seen when illuminated in a particular way, it is not of great commercial value. Methods based upon the Young-Helmholtz theory are, however, much more valuable from a practical point of view, and we are to-night to consider a process based upon this theory. It is easy, certain, and capable of securing results which may be projected upon a lantern screen, or examined in the stereoscope in exactly the same way as an ordinary hand-painted slide, or may by a further modification of the printing method, be reproduced in large numbers by the typographic press.

The first suggestion with which I am acquainted of the application of the Young-Helmholtz theory of trichromatic vision to the production of photographs in colours, occurs in a paper read by Ducos du Hauron, as far back as the year 1859. But the first practical demonstration of the process was given by Professor Clerk-Maxwell, of the Cavendish Laboratory, Cambridge, in the year 1861. In that year Professor Clerk-Maxwell delivered a lecture at the Royal Institution, and from the report of the proceedings of the Institution I extract the following :—

"Experiments on the prismatic spectrum show that all the colours of the spectrum and all the colours in nature are equivalent to mixtures of three colours of the spectrum itself, namely red, green (near the line E), and blue (near the line G.).

"The speaker, assuming red, green, and blue as primary colours, then exhibited them on the screen by means of three magic-lanterns, before which were

three glass troughs, containing, respectively, sulphocyanide of iron, chloride of copper, and ammoniated copper.

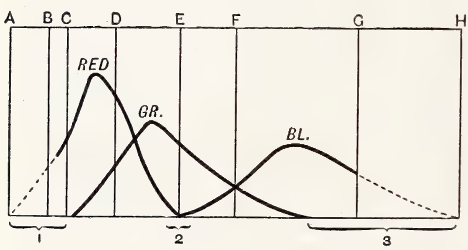
"A triangle was thus illuminated, so that the pure colours appeared at its angles, while the rest of the triangle contained the various mixtures of the colours, as in Young's triangle of colour.

"The graduated intensity of the primary colours in different parts of the spectrum was exhibited by the coloured images, which, when superposed on the screen, gave an artificial representation of the spectrum.

"Three photographs of a coloured ribbon taken through the three-coloured solutions respectively, were introduced into the lantern, giving images representing the red, the green, and the blue parts separately. When these were superposed, a coloured image was seen which, if the red and green images had been as fully photographed as the blue, would have been a truly-coloured image of the ribbon. By finding photographic materials more sensitive to the less refrangible rays, the representation of the colours of objects might be greatly improved."

The three-colour process then is based upon the fact that all the colours of the spectrum, and therefore all the colours found in nature, may be counterfeited sufficiently nearly to deceive the human eye by means of mixtures

FIG. 28.



of three colours of the spectrum itself—a particular red, a particular green, and a particular blue-violet.

I now show you upon the screen the particular colours selected as primaries by Clerk-Maxwell. The primary red is a red corresponding to a mixture of all the spectrum colours between the lines A to C. The primary green is a green matching very nearly the green of the spectrum at the line E, and the primary blue-violet is a colour corresponding to a mixture of all the spectrum colours from between the lines from F and G and H (see Fig. 28, 1, 2, and 3). Now I have the spectrum on the screen and I am able to place these Clerk-Maxwell primary filters partially over the slit so that we see on the screen the colour of the filter used and the position in the spectrum of the light transmitted at the same time. I place one of these filters in each of these three optical lanterns, and by shifting the lanterns I can cause the respective discs to overlap and you see all trace of colour disappears and we get a white disc. You will remember we performed a somewhat similar experiment in the first lecture when we recombined the spectrum and made white light, but here we have an important difference: if we examine this disc, which is a good white to the eye, by means of a spectroscope we find that instead of the continuous band of colour formed from ordinary white light we only get three sharply defined bands in the red, green, and blue.

Now let us try some experiments in mixing these three colours. I separate the discs and then cause the red and the green to overlap; where the discs overlap you see we get a bright yellow, try the red and the blue mixed we get a bright magenta or pink, try the green and the blue and we get peacock or bright greenish-blue (see Fig. 37). Here then we have the direct combinations in pairs. Let us slightly vary the experiment: let us cause all three discs to overlap so that we get the white disc and then lower the intensity of the light coming through the red filter by closing down the diaphragm in the lens, you see at once colour appears, and by varying the relative apertures of the diaphragms we can make a match to any colour.

Suppose we wish to reproduce the spectrum by means of these three colours; from the experiments we have just tried we see that three patches of the colours would not give us what we require, because we should have no orange, no yellow, no yellowish-green or greenish-blue, but from the experiment of mixing the coloured lights, we see that all these colours can be made by suitable mixtures. Clerk-Maxwell was the first to measure the proportion of each of the primaries required to reproduce the colours of the spectrum, and Fig. 28 shows us these proportions, the amount of each colour being indicated by the height of the curved lines above the base.

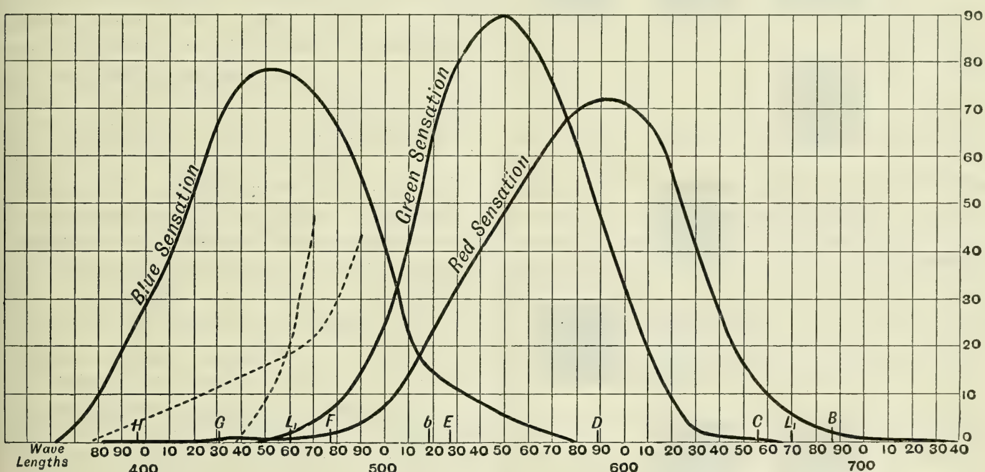
From these facts it would appear that we have only to make three filters admitting light in the proportions shown by these curve drawings, and to photograph our object through these three filters, prepare transparencies from the negatives, and project them by means of three lanterns, in order to secure a representation of the object photographed in its natural colours. At the time when Clerk-Maxwell made his classical experiment no plates were

obtainable sensitive to the whole of the visible spectrum, and it is primarily to this cause that his results were not completely successful. In 1869 Ducos du Hauron published a book upon the photography of colour, and it is upon the methods suggested in this book that nearly all investigators have worked since. Du Hauron was the first to make a photochromoscope, an optical instrument for combining the transparencies from the negatives taken through the colour filters, since further improved and introduced commercially into this country under the name of the Krōmskōp. He also devised several methods by which all three negatives could be taken at one time, thereby simplifying the negative-making; he devised the ruled-screen method of trichomatic photography, since placed upon the market commercially by Professor Joly, of Dublin, and he was the first to produce an actual photograph in colours by the use of superimposed films.

Coming down to 1888, Mr. Ives pointed out the fact that although Clerk-Maxwell undoubtedly quite understood the theoretical requirements of three-colour photography, the short report of his lecture omits one very important fact, namely, that although the projected transparencies should be illuminated by pure red, green, and blue lights, the negatives must not be taken through filters of the pure colours, but through filters admitting light in such proportions as to secure deposits in the negatives upon the particular plate used in accordance with the power of the particular sensation to excite the eye, that is say, negatives of the spectrum should show a deposit with maxima as shown in Clerk-Maxwell's drawing, Fig. 28. Practical work with screens made to Clerk-Maxwell's curves, however, soon showed us that some modification of these curves was necessary in practice, and Sir William Abney has quite recently very carefully remeasured the sensation curves, and his measurements form the basis of our work to-day.* (Fig. 29†.)

At the present day, as we have seen, (see Fig. 24, p. 771) quite a number of plates are commercially obtainable sensitive in some degree to the whole of the visible spectrum, and in order to prepare our colour filters, we may proceed in a somewhat similar manner to that adopted for the preparation of the orthochromatic filters. First settle upon the plate we are to use, and then photograph the spectrum until we get through the three filters deposits in our negatives corresponding to the curves of the power of the primary colour sensations to affect the eye; but by a modification of Sir William Abney's colour sensitometer, we are enabled to effect just as great an improvement in the accuracy and uniformity of light filters for three-colour work, as we were able to do with filters for orthochromatic work. The problem is, however, a little more difficult than the one we considered last week. We must first of all settle upon a row of coloured

FIG. 29.



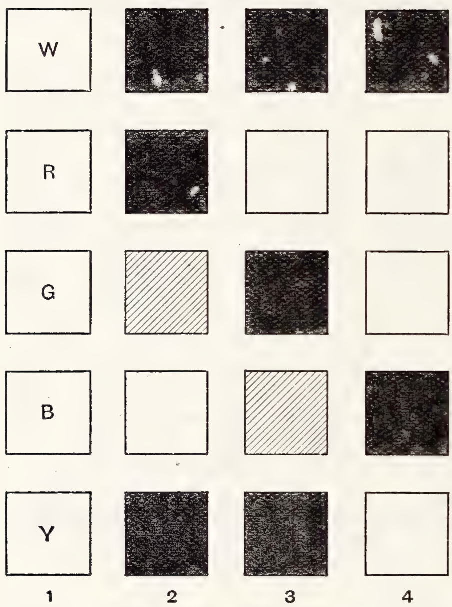
Sensation curves (normal spectrum) in which equal heights of ordinates form white (electric light crater).

* See "The Colour Sensations in Terms of Luminosity," Captain W. de W. Abney. Transactions of the Royal Society. Series A, vol. cxciii. pp. 259 to 287.

† It should be noted that this drawing is of normal spectrum; Fig. 28 is on the scale of the prismatic spectrum used by Clerk-Maxwell.

glasses to be used as a test object, we then find out what proportions of the three-colour sensations are necessary to exactly match the tint of each of these coloured glasses, and from these measurements we are able to calculate three rotating sectors for use with the row of test glasses, one for the red, one for the green, and one for the blue-violet filter. The advantage of this method of working cannot be too strictly insisted upon, the measurements are made once for all, and, therefore, time can be taken which would be quite impracticable commercially, had separate measurements to be made for each filter

FIG. 30.



1. Row of squares of coloured glasses—white, red, green, blue, and yellow.
2. Negatives taken through the red filter.
3. Negatives taken through the green filter.
4. Negatives taken through the blue filter.

adjusted. In our own practice the mean of a large number of measurements were taken, including readings by more than one person with normal eyesight, so as to ensure the greatest possible accuracy, for we must remember that measurements of colour by a person with even a trace of colour blindness would be inaccurate.

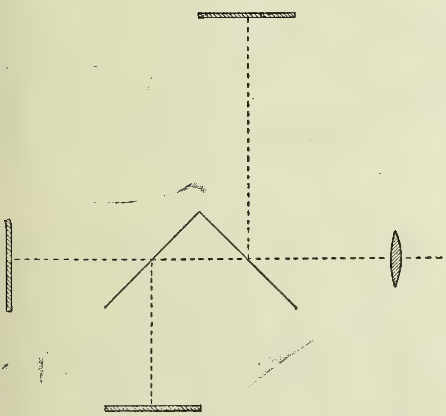
In order to show you how these filters sort out the colours of an object I have prepared our next slide (Fig. 30). On the left hand side we have as a test object a row of squares of coloured glass arranged one above another—white, red, green, blue, and yellow. Following this, we have three actual negatives of this row of glasses taken through the red, green and blue-violet filters respectively, the top square—the white one—is represented in all three negatives by a dense silver deposit of equal density, the red glass is represented by a dense deposit only in the negative taken through the red filter, the space occupied by the red glass being transparent in the negatives taken through the green and blue-violet filters. The green glass is a yellowish-green, and as we saw just now that red and green lights, when mixed, form yellow, we have a slight deposit in the red filter negative, full deposit in the green filter negative, and transparency in the blue filter negative. The blue glass is a greenish-blue, and is represented by transparency in the red filter negative, by a slight deposit in the green filter negative, and by a dense deposit in the blue filter negative. The yellow glass is represented by full deposit in the red and green filter negatives, and transparency in the blue filter negative.

Having an accurate set of light filters, we have only to expose three plates upon our coloured object through these three filters respectively, giving such exposures that a white object may be represented in all three negatives by an equal deposit, and we have an accurate record of the colours of our object, and although this record shows no trace of colour it is still just as much a record of colour as the cylinder of a phonograph is a record of sound. Very little practice in taking trichromatic negatives convinces us of the inconvenience of using separate dark slides, and we naturally turn to the very old device of the repeating back. I have here a repeating back for taking lantern slide size negatives, which may be attached to any quarter or half-plate camera. The dark slide carries a plate 8 inches long by $3\frac{1}{4}$ inches wide, and close in front of the dark slide is a frame holding the three-colour filters so that after making the first exposure through, say, the red screen, the lens can be capped and the dark slide and colour-screen frame shifted along to expose the green filter negative. After a sufficient exposure, the lens is again capped, the colour screen and dark slide pushed to the stop, and the cap removed to expose the blue filter negative; in this way we are enabled to change the plate and the light filter at the same time. This arrangement answers very well for still-life objects, but where we wish to get the shortest possible exposures, as in portraiture, we use another form of this repeating back in

which the colour-screen frames and dark slide are counterbalanced in an upright position in the repeating back, and the whole of the operations of exposure and changing the plate and colour filter is effected by means of a pneumatic bulb. The first pressure of the bulb of this camera opens the shutter, and we may count, say, 10 seconds for the exposure of the red negative, the second pressure of the bulb closes the shutter, releases the catch holding the dark slide and colour filters, allowing it to fall one-third of its length, and on releasing the pressure on the bulb, the shutter reopens for the second exposure, a third pressure of the bulb again closes the shutter and changes the plate, and a fourth pressure closes the shutter at the end of the exposure for the blue filter negative. A separate shutter slides over the lens during the time that the bulb is kept pressed, so that even with brightly lighted objects there is no trace of movement during the drop of the dark slide.

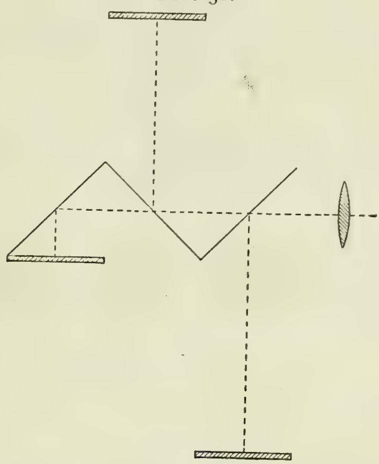
There is no reason why the whole of the exposure and plate changing should not be

Fig. 31.



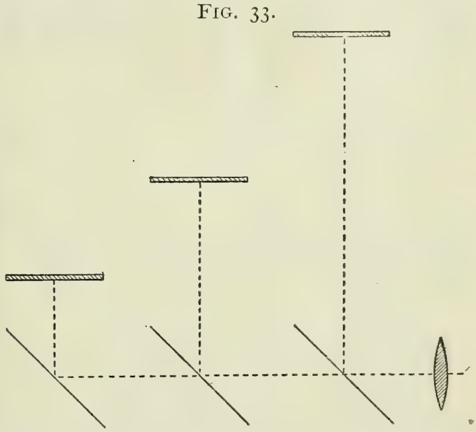
carried out by clockwork, and I have made two cameras of this type in which the pressing of a button started the first exposure, and the opening and closing of the shutter and changes of the plate and colour filters then followed in correct sequence without further attention. At first sight it seems simple to expose all three negatives at once by using a camera furnished with three rectilinear lenses placed side by side, varying the aperture of the stops of the lenses so that all three exposures shall require the same time, but a little consideration will show us that with such an arrangement only a flat surface can be copied, as the difference in the point of view will prevent objects in different planes from registering when the prints are superposed. Such a camera, however, may be used for distant landscape, cloud studies, &c., and answers perfectly for copying paintings or other flat surfaces. There are several forms of cameras available in which the three negatives are secured at one exposure and from one point of view. One of the simplest of these,

Fig. 32.



and by no means the least effective, is a form devised by Du Hauron, consisting of two transparent mirrors placed one behind the other at an angle of 45 degrees to the axis of the lens. By this means the light coming through the lens is split into three, as in Fig. 31, and three plates being so placed that each is optically at the same distance from the lens.

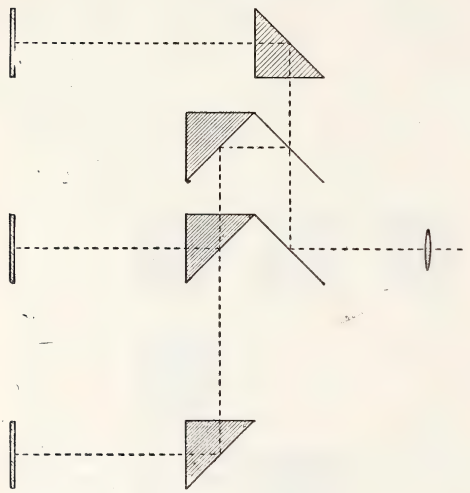
Fig. 33.



An almost endless series of changes can be rung in methods of dividing a beam of light into three by means of combinations of transparent and opaque mirrors, and I should only weary you if I described a tithe of the schemes devised. I will content myself with showing you a few slides of the best known combinations (Figs. 32 to 36).

Having secured one set of negatives we might make ordinary lantern-slide transparencies from them and project them, as Clerk-Maxwell did; but then the results will not be of much practical value, as to-day every lecturer wishes to have all his slides in such a form that they may be shown in an ordinary lantern, and give brilliant results upon a 12 to 20-foot

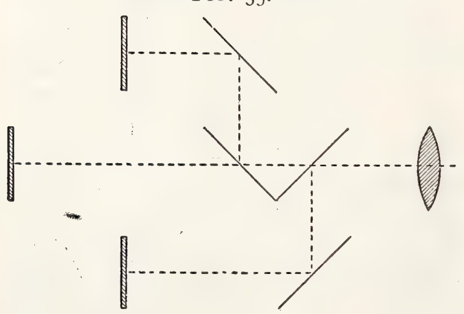
FIG. 34.



screen; even with a powerful arc light only small pictures can be projected by the triple lantern, certainly not larger than 4 feet in diameter.

By the method of printing from the negatives in transparent colours, and superimposing the prints which I have introduced, we entirely obviate the necessity for any complicated

FIG. 35.

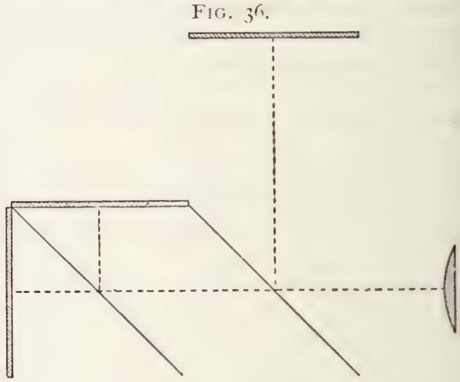


viewing device, or the enormous loss of light by the colour filters in the triple projection lantern; the slides are more transparent than the best hand-painted ones, and, of course, infinitely superior in delicacy and accuracy of colouring. They can be projected upon the screen up to discs of 12 feet by the ordinary limelight lantern (or up to 20 feet by the electric arc), or seen in the hand as a complete picture in colours by day or artificial light.

We now come to a point upon which much misconception exists, namely, the colours used for printing in superposition. I am repeatedly told that after saying so much about red, green, and blue being the primary colours, I have had to change my views and go back to the old primaries of the artist—red, yellow, and blue, for my superposed prints.

When we project transparencies from our negatives as Clerk-Maxwell did, we illuminate the transparency from the red filter negative with red light, the transparency from the green filter negative with green light, and the transparency from the blue filter negative with blue light, but when we superpose transparent prints we print not in the pure colours but in colours which transmit two

FIG. 36.

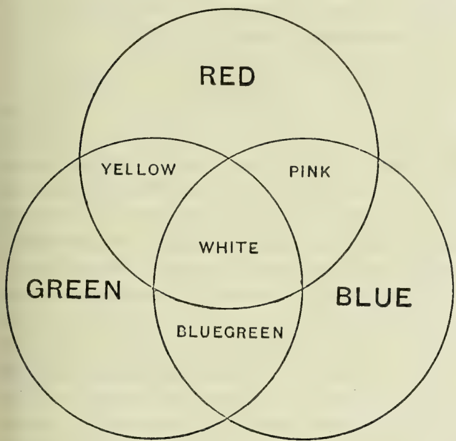


of the colours we used to form white light; for instance, the red filter negative is printed in a colour transmitting the other two colours which with, red, we used to form white light, that is a colour transmitting both green and blue. This colour is a cyan-blue—a light greenish shade of blue quite different from the deep pure blue of the spectrum; for a similar reason we print the green filter negative in the complementary colour to green, which we have seen is a pink or a magenta, and we print the blue filter negative in the complementary of blue, namely, yellow.

A little consideration will show us the reason for this change. In the experiment we made with the three lanterns and overlapped discs of red, green, and blue lights, we were adding coloured lights to coloured lights to make white, but in superposing one print over another we are not adding lights together but rather darknesses, for the print nearest the eye is abstracting still more light from the light transmitted by the other two prints.

Think for one moment what we are doing when we paint a streak of red paint on a sheet of white card, the white card is reflecting light of all colours to the eye, and appears white — the streak of red paint absorbs a part of the white light—the green and blue rays, and

Fig. 37.



makes the card appear darker because the painted streak is only sending a portion of the light to the eye—the red rays. Fig. 37 and 38 will explain the matter in a graphic manner. Fig. 37 represents the effect of overlapping discs of red, green, and blue lights, and we see the result of combining all three is white.

Fig. 38.

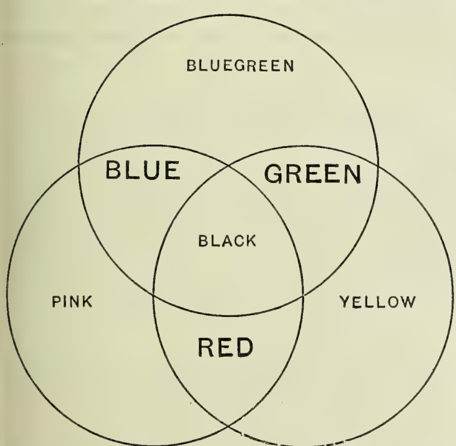


Fig. 38 represents the effect of superimposing discs of gelatine film stained with the complementary or minus colours to red green, and blue, namely, cyan-blue, pink, and yellow, and we see that where all three overlap in the centre we get not white, but black.

The red filter negative then we print in minus red or greenish blue, and the result is a slide like the one I now have upon the screen; the green filter negative we print in minus green or pink, and I will superpose this pink print upon the blue one: you see we have a very crudely coloured result, very unlike the object photographed, but when I add the third print—the print from the blue filter negative, printed in minus blue or yellow, you see we get an excellent reproduction of all the colours of the object photographed.

The minus red or greenish-blue print is made upon a gelatine bromide of silver emulsion plate, and after development the silver deposit is replaced by ferrocyanide of iron, the metallic silver acting as a mordant; fortunately the substitution product is exactly the tint of greenish blue required. The prints from the green and blue filter negatives are printed together upon a special film of thin transparent celluloid, coated with a soluble gelatine film containing a trace of bromide of silver.

This film is sensitized with a chromate salt in the manner of carbon tissue, and the celluloid side is placed in contact with the film side of the negative so that the exposures takes place through the celluloid film and consequently no transfer is necessary as in ordinary carbon printing. The image is a visible one and can be examined from time to time, the exposure being complete when all the details are distinctly seen as a light brownish grey image very similar to an undeveloped platinotype print.

The printed film is then washed out in warm water, the trace of silver bromide enabling us to see when development is complete; the silver bromide having served its purpose, is dissolved out by a solution of hyposulphite of soda, and the resulting low relief in clear gelatine washed and dried. The two prints which have so far been treated together are now cut apart, and the print from the green filter negative stained in a pink dye bath so as to get a pink print which will allow red and blue light to pass, or minus green; and the print from the blue negative is stained in a yellow bath so as to get a yellow print which will allow red and green light to pass, or minus blue.

When these two prints are dry they are mounted in superposition upon the greenish-blue print and our picture is finished. As the two film prints are reversed prints in consequence of our printing through the film, and the greenish-blue print is a direct one, the two most important components of the trip-

let, the greenish-blue and pink prints, can be mounted in actual contact, and as the third print, the yellow, is only separated by one thickness of very thin celluloid, the finished print behaves in every way as a single print.

Now the proof of the success of any photographic process lies in the quality of the results obtained by it, so in conclusion I will throw upon the screen some forty slides of widely different subjects prepared in the manner I have described.

Miscellaneous.

*WIRELESS TELEPHONY.**

The first experiments in this direction were made in the month of February, 1894, across Loch Ness in the Highlands. On that occasion trials were made to determine the laws governing the transmission of Morse signals by electro-magnetic method of wireless telegraphy, which has formed the subject of frequent reports to this Section since 1884, two parallel wires well earthed were taken, one on each side of the lake, and arrangements were made by means of which the wires could be systematically shortened with a view of ascertaining the minimum length necessary to record satisfactory signals. It occurred to Mr. Gavey, who was experimenting, to compare telephonic with telegraphic signals, *i.e.*, to ascertain whether articulate speech could be maintained under the same conditions as Morse signalling. The trials showed that it was possible to exchange speech across the Loch at an average distance of 1·3 mile between the parallel wires when the length of the wires themselves was reduced to four miles on each side of the water.

What led to this train of thought was the fact that although the volume of telegraphic current was immensely greater than that of a telephonic current whenever, through want of balance in a loop, disturbance was evident then telephonic cross-talk was also manifest. In other words, a weak telephonic current was apparently as powerful a disturber as a strong telegraphic one.

The sensation created in 1897 by Mr. Marconi's application of Hertzian waves, distracted attention from the more practical and older method. Mr. Evershed and Professor Oliver Lodge had, in the meantime, much advanced the system by introducing admirable call systems.

In 1899 the author conducted some careful experiments on the Menai Straits which principle determined the fact that the maximum effects are produced when the parallel wires are terminated by earth plates in the sea itself. It became quite evident that the ordinary inductive effects are much enchanced by conductive effects through the water, and that in consequence shorter wires are practical. No special apparatus seems necessary, and the ordinary telephonic transmitters and receivers were used.

It became desirable to establish communication between the islands or rocks known as the Skerries and the mainland of Anglesey, and it was determined to do this by means of wireless telephony. The lighthouse at the Skerries was wanted to be in communication with the coastguard station at Cemlyn. A wire 750 yards in length was erected along the Skerries, and on the mainland one of three-and-a-half miles from a point opposite the Skerries to Cemlyn. Each line terminates by an earth plate into the sea. The average distance between the parallel portions of the two wires is 2·8 miles. Telephonic communication is readily maintained and the service is a good one.

Further experiments with wireless telephony have recently been made between Rathlin Island, on the north coast of Ireland, and the mainland. The east and west portions of the island of Rathlin are about eight miles from the mainland, but a tongue of land projects southward to within a distance of four miles. Communication was required between the lighthouse near the north-eastern corner of the island and the mainland, and the question for solution was whether an overhead line running the whole length of the island from east to west was necessary to obtain good communication, or whether a shorter line across the neck of the southern peninsula would serve. The preliminary experiments that have been made prove conclusively that communication, both telegraphic and telephonic, has been readily maintained by means of temporary wires established across the neck of the peninsula along the shorter line. Wireless telegraphy across the sea is now a practical and commercial system.

No experiments have yet been made with ships, but it would appear simple to speak by telephone between ship and ship or between ship and shore to considerable distances by means of a circuit formed of copper wire terminating at each end of the ship in the sea, passing over the top-masts and using simple telephones.

* Abstract of a paper read by Sir William Henry Preece, K.C.B., F.R.S., before Section A of the British Assotiation at Bradford.

MACHINE TOOLS IN THE UNITED STATES.

The British Commercial Agent in Chicago, in a report just received at the Board of Trade from the Foreign-office, and printed in the *Board of Trade Journal*, after referring to the disadvantages under which manufacturers in that district work in respect of wages, distance from seaboard, and, in the case of South Africa trade in particular, sea freight, gives some interesting statements as to the use of machine tools which tends so much to reduce the labour bill. He writes:—" In order to be able to turn out goods

at such a rapid rate and in such large quantities only machine tools of the very latest patterns are used. Every improvement and every invention by which labour may be saved, or time economised so that the resulting cost of manufacture may be reduced, is at once taken advantage of. In all the works I have seen in this country, the one great object seemed to be to save unnecessary labour wherever possible, and to get through with the work as expeditiously as possible. In one large works which I had an opportunity of visiting, I found one man in charge of ten automatic machines, all working at the same time. Some were lathes turning small pieces, others were putting the thread on nuts and bolts, and many others. In this one shop there were fifty machine tools working, and in charge of only five men. It is not an unusual thing to see one man in charge of three or four of the ordinary small lathes. They are placed in such a position as to make this possible. Drilling machines with batteries of four or six drills are not uncommon, also machines cutting key ways in eight small axles at one time. Consequently, though wages are high, the actual cost per piece is very low on account of one man being able, thanks to these labour-saving machines, to turn out so much work. In one works I visited I was assured that ordinary labourers were being employed in place of skilled mechanics to take charge of some of the lathes and drilling machines, so as to avoid paying the higher wages of the more skilled men. They found it to answer perfectly, because, owing to the perfection in the construction of the machines, the work was almost automatic. The machines were made sufficiently strong so that an unskilled man might work them without fear of breakages, and the tools were sharpened ready for the man in charge. This was only possible, of course, where the work to be done was not of a complicated nature. As a rule, the American manufacturers do not lay themselves out for making a large variety of articles. They prefer to confine themselves to a few specialities, and make large quantities as perfectly as possible. I had the opportunity of visiting one of the largest agricultural machinery establishments where they employ, when in full work, about 9,000 hands. They confine themselves to making grass mowers, hay rakes, reapers, binders, and binder twine. Beyond making a few machine tools for their own use and doing their own repairs, the whole staff is employed in making these few articles. They consequently turn out large numbers, and, needless to say, the quality of the construction is excellent. Labour-saving machines and appliances are to be seen everywhere. In the forge, for instance, there was not a hand hammer to be seen. Nothing but tilt hammers worked from pulleys and a few steam hammers for the heavier pieces were used. The iron was heated in gas and oil furnaces. Electricity was used throughout, not only for lighting, but also for driving the machinery. Compressed air was also used as an accessory for working the crane and hoists, and also for operating the pneumatic tools for chipping, caulking, &c. In addition to the tools I have mentioned, there were many other instances where the appliances used for the saving of labour were striking. I noticed a machine for punching sixty holes in iron plates at one stroke, another for rivetting at one stroke twenty teeth on to the knife plates of grass mowers. Cart loads of timber were unloaded in a very few seconds by means of rollers placed length-wise on the carts, and the pieces of machinery were dipped into paint instead of using brushes. To mention all the apparatus I saw would be useless, but perhaps what I have mentioned will give a fair idea of the many ways by which machinery is turned out quickly and cheaply from American workshops. At the works I have seen, malleable iron castings play a very important part. They are largely used in place of forged iron. Machine tools of British manufacture do not seem to be in favour in this country. They are not considered suitable for the work to be done and are generally dearer than those of native make. There are consequently comparatively very few to be seen. The designs of some of the American tools are certainly very ingenious, and the work they do is exceedingly accurate. They also appear to run at a greater speed than the English ones."

THE PRECIOUS STONE CUTTING INDUSTRY OF BIRKENFELD.

The cutting and polishing of precious and semi-precious stones forms the chief industry of the little principality of Birkenfeld, up among the hills of the Nake River in Oldenburg, and gives employment to over 5,000 persons. Although an improved factory system is gradually superseding the laborious methods of former times, there are, nevertheless, plenty of the old polishing and cutting works, which bear evidence to the lives sacrificed to this industry. The United States Consul at Mainz says that in the early days of the trade, agate quarries existed in the adjacent hills, and this stone was cut and polished by a very laborious method, which is still practised, although the agate quarries have long been exhausted, and the raw material—as well as amethyst, jasper, opal, topaz, &c.—has been imported (since about 1834) chiefly from Brazil, whence it is shipped to Birkenfeld, to be cut, shaped, and polished for the jewellery trade. The usual method employed in cutting and polishing these stones is as follows:—In a rude hut by a stream, which furnishes the power, four large grindstones about 4 feet in diameter are so fixed that their axes are only about one foot above the floor, into which a slit is cut, so that part of the grindstone is below its level. The lowest portion passes through the water, thus keeping the stones constantly wet. The operator has a bench or block of wood, about 18 inches high, hollowed out to receive his chest and body. On the bench he lies at full length, and with his fingers holds the small piece

of opal, amethyst, or other stone which is to be cut, against the grindstone slightly above the level of the floor: in this position the men lie from morning to night, day after day. Consumption usually carries them off at an early age, but other men are found to follow this vocation, as the earnings are comparatively high. The operator usually owns his grindstone, or at least half of one. This represents an investment of about £20, and a skilled lapidary can earn from £3 to £5 per week. He does not usually cut and polish stones on his own account, but generally contracts with manufacturing jewellers, who supply him with the stones in the rough to cut and polish at a certain price per gramme (gramme = 15·4 grains). As the stones, even in the rough, represent quite an outlay of money, the honesty of the workman must be greatly relied upon, for nobody can say in advance how many grains of finished stones a certain piece of opal, amethyst, or the like may yield. Besides these semi-precious stones, precious stones such as diamonds, &c., are also cut and polished there, but this s an entirely different branch of the industry, and is chiefly carried on in factories with modern machinery. Another branch of the industry in the district of Birkenfeld is the cutting of cameos. Pearls are also polished, drilled, and cut, and shipped in large quantities to all countries.

*THE PHOTOGRAPHIC METHOD OF PREPARING TEXTILE DESIGNS.**

The preparation of designs for the loom has, throughout the history of weaving, been regarded as a purely manual process controlled by the intelligence, ingenuity, and skill of the craftsman. It is only natural, therefore, that the invention of apparatus for this specific purpose should have created much interest amongst both British and foreign textile experts. Photography, as understood and practised, appeared as incapable of aiding the artist in the actual painting of his picture as the designer in the transference and execution of the plain sketch of the pattern on to the "scale" paper for the loom. Within the wide range of technical and scientific data in the construction and embellishment of woven fabrics there is, perhaps, no phase of the work more difficult to assail, by mechanical devises, than the application and adjustment of the manifold "weave" units which compose all figured textiles.

Design acquired in the loom is a distinct type of ornamentation involved in varied technicalities. It is not the result of one but of a number of processes, overlapping each other, and yet uniting to construct and perfect the same woven effect. Fabric and design have to be simultaneously obtained. These can only be divorced by resorting to the arts of printing, embroidery, and painting. Obviously in the preparation of the "design" sketch for weaving, numerous limitations have to be encountered, which, on a first consideration, seem liable to be increased rather than diminished by a photographic process of design-development. Much ingenuity has been exercised by Szczepanik in his solution of these "weave" problems. Szczepanik's apparatus is not for the origination of designs either in the theoretical or technical form, for in both processes the knowledge of the expert are demanded; but its province is to lessen, and, in some instances, dispense with, the monotonous manual labour necessitated by the present system. There are large areas of point paper in elaborate designs to which the same weave effect has to be applied, and where some labour-saving device is much needed. Further, in the enlargement of the artist's sketch to scale there is much mechanical work that it ought to be possible to reduce. The photographic inventions of Szczepanik profess to accomplish these objects, and the designs submitted prove that there are possibilities of success in certain styles of pattern. A new field for experiment has been discovered, the extent of which it is not possible to forecast, but it may reasonably be anticipated that the genius and temerity of the discoverer will prove equal to its more complete exploration.

The essential purpose of Szczepanik's invention is to develop from the ordinary sketch and enlarge to a prescribed scale the technically-prepared design, marked with the thousands, or may be millions, of dots grouped in different orders and so fitted together as to impart precise definition to the several portions of the woven figure or design. The process is threefold, consisting (1) of the preparation of the ruled paper; (2) the development of the design from an ordinary photographic negative; and (3) the application of the weave units to the several parts of the figure. Primarily the apparatus consists of an optical lantern with a suitable arrangement of lenses. One important factor is the "raster" or multiplying plate, containing some 435,600 perforations, through each of which the weave type passes, and is printed on the enlarged design. In addition there are weave-plates for determining the details of the pattern, and small metal slides for producing particular sections in distinct forms of type, so that they may be as readily distinguished from each other as if sketched in various colours.

The light from the lantern passes through the negative of the design, entering a pair of lenses between which is fixed the small metal plate of the proper shape for developing the marks on the sensitised paper. The process consists in dividing and subdividing the "scale" pattern into rectangular spaces, and of marking each with the correct weave type. When there is no negative in the lantern this type is repeated as many times as there are holes in the perforated plate, showing the feasibility of marking every square photographically on any kind of weaver's paper.

In the first place, the negative is made of the com-

* Abstract of a paper read before Section G. of the British Association at Bradford, by Professor Beaumont.

plete design, and all parts erased but the ground sections, allowing of these being printed with their supplementary weave elements. Negatives of every part of the pattern are similarly printed in succession until the entire design has been obtained. For the production of shaded work, *e.g.*, portraits and pictorial subjects, selecting plates are employed. These secure an accurate graduation of tones perfectly in harmony with the photograph from which they are derived. Provision is made for the execution of patterns in compound as well as in single structure fabrics; but it follows, the more complex the build of the texture, the more intricate the process of design production. Certain textile designs may evidently be produced photographically by the Szczepanik system, so that it is now a question for demonstration whether designs so produced are comparable in legibility and equal for all practical purposes—as forcible in detail, as vital in execution—as those prepared by the much slower hand method.

*NATURE OF ALLOYS.**

Most students believed that certain definite chemical compounds existed in alloys. To prove this, however, certain means must be adopted to abstract the particular compounds. Ordinary chemical means of isolation were of no use under the circumstances. Fractional solution was effective in some cases, and by means of it several distinct metal compounds had been isolated from alloys, such as platinum-tin, copper-tin, zinc-copper, and other compounds. Another method was by observation of the "freezing point;" the molten mixture was cooled down slowly, and the temperature noted at which solid matter began to separate from the liquid. This varied with the proportion of the constituents, and by making many observations with varying proportions, a curve could be obtained of these solidifying temperatures, any irregularity pointing to the formation of something other than a mere mixture. By this means many interesting facts had been indicated which had subsequently been rendered evident by examination under the microscope. Valuable and interesting results had been thus obtained, both in this country and abroad, Professors Roozeboom and Le Chatelier having particularly distinguished themselves in this direction. A remarkable instance of peculiarity was exhibited by mixtures of aluminium and antimony when all the mixtures froze at a higher point than either of the components, and showed two irregularities indicative of two distinct compounds. In these mixtures it appeared that the component that predominated to a considerable extent acted as a solvent to the compound formed with the other component; but as the proportion of the other component was increased the conditions became reversed. Interesting results had been obtained by observing, not only the freezing point, but also the point where the whole mass solidified, so that for every mixture the exact composition of the mass from which the compound had separated and of the separated compound was indicated. Röntgen-ray photography had also been utilised to demonstrate the formation of these intermetallic compounds. A long list of known and supposed alloy compounds was given in the report, and it appeared that the atomic relations generally held by chemists did not hold in the case of alloys.

* Abstract of the Report of the Committee of the British Association. Read at the Bradford Meeting by F. H. Neville, F.R.S.

POULTRY BREEDING IN BELGIUM.

The "poulet de Bruxelles" has a very widespread reputation not only among gourmets, but among all who have had the good fortune to travel upon the Continent and partake of it. The difference in quality between the fowl above mentioned and one of the same age and size of the ordinary variety is shown by the fact that the first is sold in nearly all the markets in Belgium at double the price of the other. For example, a young poulet de Bruxelles which would be considered about the size sufficient for a meal for two persons is sold for about 4s., whereas one of the ordinary variety can be purchased for between 1s. 8d. and 2s. 6d. The excellence of the fowl seems to depend, as far as can be ascertained, on the careful manner in which the sitting hen is treated, the cleanliness observed about her, as well as the careful feeding of the young chicken until sufficiently developed for eating purposes. The United States Consul-General at Antwerp says that whether or not the methods pursued in Belgium differ from those followed by careful breeders in other countries it is impossible to say. The choice of eggs for setting purposes is considered a matter of great importance, and the freshest obtainable are almost invariably used. The best breeders seldom take eggs older than eight days for raising the best quality. Care is taken that the eggs given to one hen should be of the same age. The eggs when collected are kept at a very even and medium temperature until given to the hen, and are turned daily. This is done to prevent the yolk, which is lighter than the white of the eggs, from adhering to the top of the shell The eggs chosen for the purpose above mentioned are also of an average size, those above medium being rejected, as they often contain double yolks. Eggs received from a distance, and consequently exposed to more or less shaking, are allowed to stand a day or two before being put under the hen. Great care is also taken that the eggs should be perfectly clean. The nest is prepared of straw or cut hay, perfectly clean, dry, and odourless. As a rule, the sitting hens are placed in corners where

the greastest quiet is obtainable, and are not exposed to great light. When so situated they are not disturbed for any other purpose than the placing before them of their daily supply of food and water. As the hen leaves the nest at least once a day to search for food, to take exercise, &c., care is taken to place her food and water within reach of the nest, in order that the time that she is off the eggs may be materially shortened. When the young bird is hatched it retains in its body part of the yolk of the egg from which it was produced, which suffices to nourish it for the first twenty-four hours, during which period only warmth is required, which is furnished either by the mother hen or must be afforded by a warm cloth, in case of the necessity of awaiting the hatching of the rest of the brood. The food first given can be varied, but must be made up of ingredients containing large quantities of nitrogen, as this is required for the formation of the tissues. It is necessary, in fact, that the food should be composed of matter resembling in character an egg, together with milk. It is customary to mix with the food eggs, milk, and the blood of earth-worms, field-worms, and that of a commoner variety of fish; also to introduce, for the formation of bone, certain quantities of phosphate of lime, found in grain and flour. In the early days flour is generally given on account of the facility of its digestion, grain being substituted as the birds begin to gain strength. Wheat-flour is generally used. The grain given is wheat, rice, millet, buckwheat, and Indian corn, raw or cooked. Cooked potatoes are also often given as a change of diet. It is customary to vary the grain diet as much as possible, and to administer it mixed. The food ordinarily employed is made up as follows. Hard-boiled eggs and wheat flour are mixed in milk, a little water being added. To this paste is added a small onion finely cut up, together with lettuce when green food is scarce. The mixture is usually quite stiff, as food which is too moist is considered harmful for the young brood. After the first few days a small quantity of whole grain is mixed into the paste, but if rapid development is desired, the simple paste should be continued alone. Great care is taken to keep the young brood in a dry, warm locality, which precaution, together with the proper food, prevents inflammation of the intestines, and similar troubles. As a rule the birds are cooped up on wet days, and allowed to run about as much as possible only in fine sunny weather. In winter a more generous diet is given to enable them to withstand the cold. The daily ration of grain for the fowls is from 2½ to 4 ounces.

THE HARD WOODS OF PARAGUAY.

Quebracho is one of the most profitable woods in Paraguay. It yields an extract used for tanning leather. The forests of Paraguay are said to be full of it, and among other trees in the unexplored territory west and north-west of Paraguay are the following:—Virapuita, virara, lapacho (very heavy, and a fine hard wood much in request in Buenos Ayres), jacaranda, palo santo (which derives a fragrant odour from its resin, and from which a fine extract is made), and curupay, which is excellent for building purposes, and whose bark contains tannic acid. The United States Consul at Asuncion says that quebracho and the other woods named are found in the west and north of Paraguay. In the south-eastern part, 360 miles along the Alto Parana, stretches a forest full of the most precious hard woods as follows:—Incienso, with an extract used as incense in the churches; curupay and lapacho, the last more abundant than in the north; urudai, timbo, iviraro, piteribi, quayavi, &c. Cedar grows widely, the trees are about 80 feet high and 12 feet or 15 feet in circumference. The bark is used for tanning. A league of land in Paraguay containing cedar costs about £200.

General Notes.

THE AUTOMOBILE FOR ELECTRIC STREET TRACTION.—Mr. J. G. W. Aldridge read a paper at the British Association on this subject. After a reference to the drawbacks and difficulties incident to the usual means for carrying street traffic, he described a system which was in actual use in the outskirts of Paris. The electric motor vehicles derived power from a pair of trolley wires supported on short brackets along one side of the road; on these wires ran a two-wheel trolly containing a small electric motor for its own propulsion, the whole being connected to the omnibus by a flexible cable attached to a pole on the roof, devices being also provided to keep the cable sufficiently taut and to obviate any risk of derailing the trolly. Continuous current at 500 volts was supplied to the omnibus motor *via* the trolly wheels and flexible cable, which also contained three small conductors serving to convey back to the trolly motor the three-phrase current driving it. This was derived from the omnibus motor, which was provided with three collecting rings on the armature at the end remote from the commutator, and connected to suitable points in the winding. By this arrangement synchronism was maintained between the speeds of the vehicle and trolly motor, but in addition there was provided on the trolly motor an electro-magnetic brake, which would be energized at will through a sixth wire in the flexible cable. The omnibuses were specially built vehicles, weighing about three tons empty and five tons loaded, and were furnished with solid rubber tyres; at ordinary speeds the power required to propel them was from 130 to 160 watt-hours per ton-mile on level roads.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS FOR 1901.

The Examination Programme for 1901 is now ready, and can be obtained on application to the Secretary. The price (post paid) is 3d.

For some time past the addition to the Examinations of an Elementary Grade has been pressed upon the Council, and they have therefore added such a grade to the system of Examinations. Particulars about it have already been published in the *Journal* (see *Journal* for the 15th June), and will be found in the Programme. The Council have also in contemplation the addition of a Higher Grade, but the arrangements for this are not complete, and no examination in it will be held in 1901.

The Elementary Examinations in Languages will be dropped, their place being taken by the new Preliminary Examinations. The Examination in Domestic Economy will also be discontinued. The practice of recommending special text-books has been abandoned, except for certain subjects where the information seems to be necessary. Certain alterations have been made in the form of the present year's Programme, which, it is hoped, will make it more convenient for reference.

The standard for the General Grade (Grade II.) will be the same as that of the existing examinations of the Society, and the regulations will generally be the same as those previously in force, except that, in addition to the certificate granted in each subject, a Certificate of Proficiency in Commercial Knowledge will be issued to any candidate who has passed in the following five subjects within a period of three years:—(1) Arithmetic (2) Book-keeping, (3) Précis-writing, (4) Shorthand, (5) a modern language.

The examination in the Preliminary Grade (Grade I.) will be adapted to the attainments of the genuine continuation school pupil who, after reaching Standards VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. There is, however, no limitation of age.

Pass Certificates will be given in each of the subjects enumerated. In addition, a certificate of Proficiency in Elementary Commercial Knowledge will be given to any candidate passing in the following four subjects within a space of three years:—(1) Handwriting and Correspondence, (2) Shorthand, (3) Elementary Book-keeping and Office Routine, (4) Commercial Arithmetic.

Every pupil, before he is given his Certificate of Proficiency, will be required to produce such evidence of general education as that he has been in Standard VI., or has gone through the Third year course of a Higher Elementary School, or has passed the lowest grade of the examination of the College of Preceptors or the Preliminary Local Examinations, or otherwise has reached such a standard of general education as may appear satisfactory to the Council.

Examinations will also be held in the following optional subjects:—(1) Commercial History and Geography, (2) Preliminary French, (3) Preliminary German, (4) Elements of Type-writing.

In both Grades all the subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The Fees will be:—In Grade II., as now, 2s. 6d. for each subject, and 2s. 6d. for the Certificate of Proficiency. In Grade I., 2s. for each subject, and 2s. for the Certificate of Proficiency.

The dates of the Examinations will be March 18 to 21 inclusive, 1901.

Proceedings of the Society.

CANTOR LECTURES.

THE PHOTOGRAPHY OF COLOUR.

By E. Sanger Shepherd.

Lecture IV.—Delivered March 26, 1900.

In the process of Natural Colour Photography considered last week each positive picture requires to be dealt with separately, and naturally this takes up some considerable

time. For lantern slides, stereoscopic slides, and transparencies the method answers perfectly, but when we come to the use of the tricolour process for book illustration, advertising purposes, &c., we want to get our picture upon paper and to print thousands of copies in a very short time. For the purpose of printing large numbers of copies in a short time with a reasonable amount of uniformity the typographic press possesses many advantages. Once the blocks for typographic printing are prepared hundreds of thousands of copies can be printed without showing signs of deterioration. We therefore wish to find out the most suitable method of utilising our colour record negatives for typographic colour printing. This problem corresponds in many important respects to the method we considered last week, for whatever means we use to secure the three graduated colour prints the result must be practically equivalent to three transparent colour films backed by a sheet of white paper. Briefly then, the method is as follows:—Three negatives of the object to be reproduced are taken through coloured light filters as before described (see page 784).

Three transparencies are made from these negatives, and from the transparencies three half-tone printing blocks are prepared. The block from the blue filter negative is printed in minus blue or yellow, the block from the green filter negative is printed in super-position upon the first print in minus green or pink, and the block from the red filter negative is printed last in minus red or cyan-blue ink.

Let us go through the separate operations and see what modifications of the general outline given above are necessary in practice.

First a word or two about the printing colours. We saw upon the screen last week what these printing colours should be, but it is one thing to obtain a particular colour by the selective absorption of aniline colour in gelatine films and quite another thing in practice to match the colours so found in hue and purity in printer's ink, for we must remember that the colours must be fairly permanent, and at the same time form an ink which will distribute evenly, and give a clear impression of the right intensity from our block. Up to the present time I have been unable to find any printing inks which comply strictly with all the above conditions, and we therefore have to use the best substitutes we can obtain, and modify our light filters so as to compromise as accurately as possible for the deficiences of our printing inks.

Now with regard to the negatives. A very large proportion of commercial three-colour work consists of the reproduction of coloured drawings, and therefore we may easily secure all three negatives by one exposure, by using a camera fitted with three rectilinear lenses, and even where the copy is too large for this method, there is very little difficuly in securing the negatives successfully, as all modern process studios are equipped with electric light, and with a modern high-class type of automatic electric lamp, supplied from the mains, and controlled by a variable resistance of ample capacity, our light should be practically uniform in intensity and quality. An ammeter and volt meter should be in circuit, and if these two instruments are examined before each exposure the necessary exposure for each negative may be calculated with certainty.

There are two methods in use of preparing negatives for typographic work. In the first, known as the indirect method, the negatives are taken, transparencies made from them by contact, and half-tone negatives made from the transparencies; where, however, the copy is of little value, the selective colour negatives and half-tone negatives can be made at one operation by placing the cross line screen for producing the half-tone in its usual position a little distance in front of the sensitive plate, and having the red, green, and blue light filters mounted in cells to fit on the hood of the lens. Although the Cadett spectrum plate is very rapid, perfectly clean dense negatives, capable of yielding good prints upon copper by the enameline process, may be obtained by simple development, without any after treatment in the way of intensification or reduction—two processes very inadvisable in colour work, as however carefully carried out, they are sure to alter the gradations of the three negatives unequally. Personally I have not made any negatives upon the spectrum-plate with very fine screens, say over 175 to the inch; but up to 175 lines to the inch, perfect negatives are easily obtained.

Owing to the comparatively coarse grain of the rapid dry plate, the negatives are very different in appearance to good wet plate negatives, but the final result as an etched block is perfectly satisfactory. This direct method should not be used for valuable copy, on account of the risk of injury from the great intensity of the light necessary. Most of you here to night are process workers, and you know that it is impossible to secure a satisfactory dot in a half-tone negative unless the

copy is brightly illuminated. No amount of length of exposure will compensate for deficiency of illumination. A certain intensity of light must reach the sensitive plate through each opening in the screen before a satisfactory dot can be obtained; and taking into account the lowering of the intensity of the light by the colour filters, in addition to the ordinary half-tone screen, a very bright light must necessarily be employed for successful work.

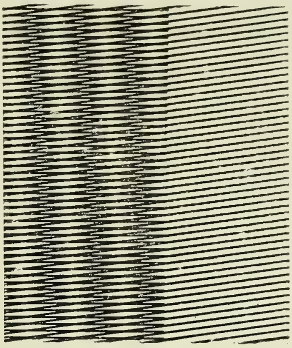
In preparing negatives and transparencies for the indirect method, care must be taken to keep both negatives and transparencies thin. Most of you know that a thin negative will always give a better enlargement than a dense one, because, in copying in the camera, we to a large extent get rid of the scattered light. A transparency suitable for making a negative by contact, would only yield a very hard result, deficient in half tones, if copied in the camera. It is advisable that all three of the original negatives should be developed together in one dish. In making the transparencies and half-tone negatives, the same course should be followed, and every endeavour should be made to get as good a reproduction of the transparency as possible in the half-tone negative by simple development. The use of the reducer or intensifying solution as commonly practised is not only unnecessary, but absolutely fatal to the attainment of satisfactory results.

There is one point of very great importance in making the screen negative—the question of the angle of the lines of the screen to one another.

Very early in the history of colour printing the lithographic printer found that the use of mechanically-ruled lines for tints was strictly limited, as, if one lined tint was printed over another at a small angle, most offensive geometrical patterns were produced. I have two lined plates in the lantern, and as I revolve one plate over the other you see that at certain angles the very fine lines produce large Japanese-matting-like patterns (Fig. 39). I try two discs of crossed lines, and you see the result is still worse.

By experiment we find that when three cross-line half-tone blocks are printed one over the other, the least offensive pattern is produced when the lines cross at an angle of from 22 to 30 degrees, and in making the half-tone negatives some arrangement must be made to secure these angles. Where the colour print is small the three transparencies can be mounted on a sheet of glass at the correct angles, and the negatives of all three taken at one operation through an ordinary cross-line screen; obviously though in this case it will be necessary to use a screen several times larger than the size of the colour blocks required, and as cross-line screens are very expensive, some other plan must be found for large sizes; for instance, we may fix a square cross-line screen in the camera and revolve the copy, or we

FIG. 39.



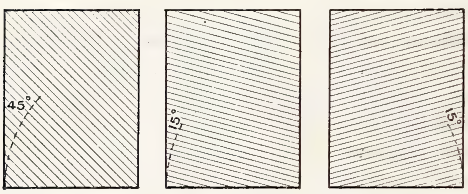
may keep the copy in one position and make some arrangement to rotate the cross-line screen in front of the plate; in either case it is obvious that the screen must be considerably larger than the colour block required. Say our cross-line screen is 12 inches square, the limit of size available in practice would not be more than a circle of about 11 inches in diameter, and, if our block is square or oblong, the largest colour block we could make with it would be still smaller, about $8\frac{1}{2}$ by $6\frac{1}{2}$ inches. Such a method of working involves the use of a camera of much larger size than would otherwise be necessary, with a corresponding increase in labour.

During the last year or two a new plan of working has been introduced, which allows of a set of negatives being made the full size of the plate the camera is capable of taking; in this method two crossed-line screens are used, in one screen the lines are ruled diagonally to the side of the plate, as usual at an angle of 45 degrees from the horizontal, and in the second the lines are at a more acute angle to the sides of the plate, say 15 degrees from the horizontal (see Fig. 40). To use such a pair of screens we take the transparency from the negative made through the blue-violet light filter, and make the half-tone negative through the usual cross-line screen—the one ruled at an angle of 45 degrees with the horizontal. We take the second screen and make the screen negative from the transparency

made through the green-light filter, placing the cross-line screen in the carrier so that the lines run downwards from left to right. To make the third negative we use this same screen simply turned round so that the lines now run downwards from right to left (see Fig. 40). By this device, with a pair of 15 × 12 screens it is possible to produce negatives in practice up to, say, 14 × 11 inches. The exposures should be made through two different sized stops, the exposure for the shadows being made with a small round stop, by which means we obtain dots which graduate very slowly in size with the varying amounts of exposure caused by the lights and shades of the picture—these dots never get large enough to close up and make high lights: the exposure to build up the dots and properly graduate the high lights is made by taking out the small stop and substituting a much larger one.

The shadow exposure with the small stop will take several minutes, but the second exposure with the larger stop to close up the lights

FIG. 40.



must be much shorter; whatever relative times and screen distance are found to give the best result from one of the transparencies should be used in making the negative from the other two, or hopeless errors in the graduation of the prints will occur.

Two round stops will generally be found quite sufficient, and as I have said before, and cannot too strongly emphasise, every endeavour should be made to get good dense dots with clear interspaces by simple development alone.

The prints are best made upon copper by the enameline process; all three should be printed and washed out together, or when working large sizes under as nearly identical conditions as possible. After careful examination for spots, &c., all three plates should be given a straight etch for the same length of time and proofs pulled from the plates in black ink upon good enamel paper. Careful comparison between these proofs and the transparencies should then give us a very fair idea of the amount of success obtained.

A few prints are now printed in the yellow ink from the yellow printing plate and allowed to dry, the pink prints similarly printed on the top of the yellow and dried, and the blue print printed last. There is no theoretical necessity for printing in this order, but in practice it is best to do so. Theoretically all three inks should be quite transparent, but unfortunately nearly all permanent yellow printing inks commercially obtainable are opaque, but by printing the yellow print first, the opacity of the pigment does not affect the finished result. The pink print is printed secondly because a slight difference in the quantity of ink (*i.e.* strength of the print) is not so noticeable in the pink print as it would be in the blue, and where the pink print has been printed a little too strong, by allowing a little more ink in printing the blue impression, we can to some extent compensate for the accident, any variation of the intensity in the blue print being very much more noticeable in its effect upon the finished result, than a variation of a similar amount in the pink or yellow prints.

A word or two about the actual printing. Obviously, where the accuracy of the finished result depends so largely upon each of the three printings, the yellow, pink and blue, being of exactly the right depth, the distribution and feed of the ink in the press must be as perfect and uniform as possible. Fortunately, there are presses in the market in which these points have been very perfectly thought out, such as the "Phœnix" press and the "Colt" press made by the John Thompson Press Company. In both these presses, the whole of the working parts are very substantial, and a very true even impression can be obtained, the ink duct and distributing and inking rollers are so arranged as to give a very perfect feed of ink, and very long runs can be printed with great uniformity.

The paper available for printing is a matter of some importance. For printing such necessarily shallow blocks as the modern fine half tones, a smooth surface of paper is essential, and the cleanest impressions are secured upon an absorbent paper, so-called enamel papers being most largely used, because of the absorbent nature of their coating and highly polished surface, but I think such papers have one or two very objectionable points. For one thing, I do not think we can rely upon their permanency, and they are liable to turn yellow by exposure to light. I have recently handled some samples of fine rag-made paper with a very highly-

finished surface, secured by a system of hot callendering. If such papers can be made at a reasonable price, and will take the ink well, I should prefer to use them in place of the enamel-coated papers.

In conclusion, I want to say a word about a totally new departure in printing with which I have lately had an opportunity of experimenting. I allude to the Orloff colour-printing machine, the invention of Ivan Orloff, of the Russian State Printing-office at St. Petersburg. Until the introduction of this machine, colour printing has been carried out by printing one impression upon the paper, allowing it to dry, and then printing the second impression, and so on; but in the Orloff press, the whole of the colours necessary to produce the coloured reproduction are applied to the paper at one impression. By this means many important advantages are secured. The difficulties of registration, expansion, and contraction of the paper by atmospheric changes, &c., are entirely avoided, and as the whole of the colours are applied at one impression, we see at once the finished result, and the intensity of colour can be regulated with great exactness. This new departure in printing is effected by the blocks parting with their ink, not directly to the paper, as is usually the case, but on to an intermediate elastic transfer roller, the transfer roller taking up the inks from the various blocks, and transferring it to a plain metal plate, from which the whole of the collected colours are transferred to the paper by a single impression.

Let me explain to you the elements of this machine.

Upon a substantial framework two cylinders are mounted; one of these cylinders (the impression cylinder) carries the sheet of paper to be printed, and is geared into the second cylinder, which carries the colour blocks. Say we have three colour blocks to be printed in yellow, pink, and cyan-blue: the blocks, or rather, I should say plates, are bent to the curve of the cylinder and fixed in position by bolts; a plain surfaced curved plate of similiar size to the desired colour print is also mounted on the cylinder, and it is this plate only that comes into contact with the paper; around the cylinder are as many ink ducts and distributing and inking rollers as the number of colours we wish to print—in this case, three—and by means of adjustable projecting ribs at the sides of the cylinder, the inking rollers are kept off the engraved plates except at the moment when each plate is immediately underneath its particular inking roller; at this point a gap in the projecting rib allows the roller to sink down into contact with the engraved surface, which receives its even film of coloured ink.

Geared into this forme cylinder is another cylinder of much smaller diameter, covered with a thin layer of elastic roller composition, or in lieu thereof by a sheet of india-rubber, and this roller picks up the ink from the inked formes as the cylinder revolves; this "transfer roller," as it is called, in its turn deposits the coloured inks it has picked up from the engraved curved plates upon the plain-surfaced curved forme plate, so that by the time the plain forme plate arrives at the point immediately opposite the impression cylinder with its sheet of paper, it has upon its surface the complete coloured picture.

As I have described it the machine may seem intricate, but it is really simple, and no one can see it in operation without at once appreciating its advantages. Unfortunately no illustrations of the machine are available, but Mr. W. H. Ward, who has introduced it into England, has promised to read a paper upon it before this Society, and I am sure it will be a very interesting one.

I have arrived at the end of my programme, but I cannot conclude this course of lectures without acknowledging the very able assistance I have received in their preparation from my colleague Mr. R. Lincoln Cocks.

Miscellaneous.

*METALLURGICAL PROGRESS IN ENGLAND AND FRANCE.**

Three periods, which for the purpose of description may be considered to be decennial, separated the universal exhibitions which were successively held in Paris in 1855, 1867, 1878, and 1889. The progress made in each of these respective periods has been indicated by the three words, "novelty," "quantity," and "quality." In attempting to characterise the progress revealed in the present Exhibition by a single expression corresponding to the above, I would choose the word "intensity." In 1855 the metallurgy of iron and steel was almost stationary. The time-honoured processes were seen to be inadequate, and technical workers were eagerly seeking

* Extract from the Presidential Address of Sir William Roberts-Austen, K.C.B., F.R.S., delivered at the meeting of the Iron and Steel Institute in Paris, 18th September.

fresh guidance. Twelve years elapsed, and the results of new efforts were revealed in the Exhibition of 1867, to which the labours of Bessemer, Martin, Siemens, Cowper, Whitworth, and Armstrong contributed so much to the general advance, and in such original ways. This was essentially the period of novelty. Eleven years elapsed, the Exhibition of 1878 showed the extraordinary development the new processes had attained, and this was the period in which the quantity of the new products was so remarkable. Then came the period during which the quality of material improved, and the metallurgical exhibits in the Paris Exhibition of 1889 made it abundantly evident that the quality of steel, which was originally considered to be a treacherous material, had attained a high point of perfection. New properties were developed in steel by the addition of certain elements such as silicon, and more especially by the rarer metals, such as manganese, chromium, tungsten, and later nickel. The result was that varieties of steel possessing distinct qualities were adapted to a wide range of application. Some kinds of steel were characterised by extreme hardness, while others were very soft; some were magnetic, in others the magnetic permeability was low; some varieties would harden by rapid and others by slow cooling; certain kinds would even contract when heated and cooled. In all cases the importance of submitting the materials which possess such strange and novel qualities to suitable thermal treatment became evident. In this way the period between 1889 and 1900 is reached, and this period I have already characterised by the word "intensity." No process of marked novelty has been devised, though there have been modifications and developments of the existing processes, and the scale on which they are conducted has been greatly increased.

Berthier prepared the first alloy of chromium and iron in 1820. Brustlein had manufactured these alloys in the works of Jacob Holtzer since the year 1877. Chrome steels have passed beyond the crucible stage, and are prepared on the open-hearth with 3 per cent. of chromium, as is also a triple alloy of iron, chromium, and nickel for use as armour-plate and in artillery. As regards our English efforts, we all know how much Hadfield had done in extending the use of iron and chromium alloys for projectiles. At about the same that Berthier gave us the first alloy of iron and chromium, Faraday prepared the first specimen of an alloy of iron and nickel, the future of which has proved to be so great. In the year 1884 M. Marbeau, of the Société Ferro-Nickel, produced their first alloys. The Journal of our Institute for the year 1889 contains a paper by James Riley, "On the Alloys of Nickel and Steel." In France, at Montataire, and at Imphy, attempts were also made to prepare alloys of iron and nickel, while at Le Creusot, in 1888, a systematic study was made by M. Werth of the alloys of nickel with iron and with steel, a study which he continued at Fourchambault and at Imphy, and obtained results of practical importance. The manufacture of nickel steel in the open-hearth furnace was undertaken at Le Creusot. I have not referred in this brief summary to the other elements which are present simultaneously with nickel. I need only appeal to results shown in the present Exhibition as indicating the way in which efforts to apply nickel steel have been intensified. As regards the alloys of iron and manganese, the English name of Josiah Marshall Heath will be familiar to you all. A French engineer, M. F. Valton, director of the Terre-Noire Steel Works, was, however, among the earliest to give an explanation of the part manganese played as a deoxidiser in the final stage of the Bessemer process; and in 1868 Siemens called attention to the peculiar action of manganese on steel, and pointed to the influence of silicon in enabling sound castings to be produced. Hadfield, about the time of the former exhibition in Paris, astonished the metallurgical world by producing steel containing from 7 to 21 per cent. of manganese, and possessing remarkable properties. His later work on the same alloys has only served to intensify interest in his earlier investigations, and it affords another instance of the renewed efforts which characterise the last decade. I will not weary you by passing in review the other alloys of iron, such as those with silicon, tungsten, and titanium; but I must not omit reference to the researches of MM. Moissan and Charpy on boron steel, of which we shall hope to hear much more in the future. May we not hope that in the next century vanadium, uranium, molybdenum, and even glucinum will prove as faithful allies as certain of the better-known metals have been.

*TEA PLANTING INDUSTRY IN CEYLON.**

From 1837 to 1882 Ceylon was a great coffee-growing country, and no one dreamed then of the fragrant leaf taking the place of the fragrant bean; but, through a disease which defied cure (much like that of the grape vine) coffee rapidly failed, and then some planters began to grow the tea plant, which had been known in the island for a good many years.

By 1882, over 20,000 acres had been planted with tea, but the export that year was under 700,000 lbs. Five years later the area planted was 170,000 acres, while the export had risen to nearly 14,000,000 lbs. By 1892, there were 262,000 acres covered with tea, and 71,000,000 lbs. were that year exported. In 1897 we had 350,000 acres planted, and the export was 116,000,000 lbs. And now in 1900, the total area cultivated with tea is not under 380,000 acres, while the estimate of shipments for the current year is not much under 140,000,000 lbs.

Never in the history of agriculture has there been a more extraordinary supercession and development than that of tea taking the place of coffee, and spreading far beyond its limits in Ceylon. The maximum area ever under coffee was 272,000 acres in 1877, when

* Paper by John Ferguson, editor of the *Ceylon Observer*.

the total export of that product was equal to 103,000,000 lbs. Twenty-three years later we have only a few thousand (perhaps 7,000) acres of coffee left in the island; but we have 380,000 acres yielding 140,000,000 lbs. of the purest tea.

Ceylon plantations of tea are now found at all elevations from a little above sea level to well-nigh 7,000 feet altitude. They number in all about 1,600, with as many European managers and assistants, giving employment to well-nigh 400,000 Tamil men, women and children. Nearly every plantation has its factory, with the machinery necessary to prepare the leaf as brought in from the bushes, until it is the tea of commerce, all the processes being attended with the strictest care and cleanliness, so that no tropical product is prepared and packed with greater attention and intelligence than pure Ceylon tea. The island where it is grown is generally acknowledged to be one of the most beautiful in the tropics, well deserving the poet's designation, "The Eden of the Eastern Wave." The total amount of capital at present invested in the tea industry in Ceylon cannot be less than £9,000,000 sterling, and the profits are cut very fine indeed, so that the buyers of Ceylon tea now get the cheapest and best tea in the world, considering its quality.

The fine quality of Ceylon tea very early attracted attention in the London market, and in a few years, so soon as there was a sufficiency to meet requirements, these teas went into consumption all over the United Kingdom, and have ever since maintained their leading position.

In Australasia — the greatest of tea-drinking countries — Ceylon teas became first favourities almost as soon as they were introduced, and the result of chemical analyses by the official analyst during the Melbourne Exhibition of 1881 confirmed the good opinion and led to a rapid supercession of China tea, and also to Ceylon being preferred to Indian tea for general consumption.

In the Canadian Dominion, too, Ceylon tea rapidly took a first place, and it is coming more and more into consumption. So, on the continent of Europe, and in Russia especially, Ceylon tea has been welcomed and is being increasingly used.

All this is more fully shown in the following account of the treatment of tea under the British Customs tariff, and its extended use in other countries.

In the year 1837 the Customs duty on tea imported into the United Kingdom of Great Britain and Ireland was 2s. 1d. per lb. avoirdupois; the total consumption for that year was 30,625,206 lbs. (or less than $1\frac{1}{4}$ lbs. per head of population per annum), and the total of revenue collected from the duty was £3,190,125. Not much change took place until Mr. Gladstone became Chancellor of the Exchequer, and then between 1852 and 1865 a series of financial reforms, due to his initiation, took place, and we find the Customs duty at 1s. 10d. per lb. in 1854, at 1s. 5d. in 1858, at 1s. in 1863, and then it was reduced to 6d. per lb., to take effect from 1st June, 1865. The result of this policy was not only a largely increased consumption of tea, but eventually an increase as well of the revenue derived from the duty.

The progress in consumption and revenue may be indicated as follows:—

Year.	Total comsumption.	Per head per annum.	Duty per lb.	Revenue.
	lbs.	lbs.	s. d.	£
1837..	30,625,205	$1\frac{1}{4}$	2 1	3,190,125
1867..	111,061,160	$3\frac{1}{2}$	0 6	2,776,529
1879..	160,432,000	$4\frac{1}{2}$	0 6	4,010,800
1887..	183,635,885	5	0 6	4,590,897

The next reduction was on 1st May, 1890, when the tea duty was reduced from 6d. to 4d. per lb., and the result is thus shown:—

Consumption of Tea in United Kingdom.

	lbs.
1887	183,635,885
1890	194,008,492
1891	202,456,837
1892	207,120,825
1893	208,047,385
1894	214,341,044
1895	221,800,137
1896	227,785,500
1897	231,399,774
1898	233,790,520
1899	241,410,240

The consumption and revenue for 1899 are as follows:—Total consumption, 241,410,240 lbs.; per head per annum, $6\frac{1}{2}$ lbs.; duty per lb., 4d.; revenue, £4,023,504, or £833,379 more of revenue than when the Customs duty was 2s. 1d. per lb. in 1837; while the total consumption of tea is now eight times as great, and per head of population is five times more.

No more wholesome or refreshing beverage than tea can be used by any people. It is a drink that makes for peace and contentment as well as health. This is is evidenced in the case of the population of the Australian colonies, who are the greatest drinkers of tea in the world, averaging over $17\frac{1}{2}$ lbs. per head, in their consumption, per annum; while they (the Australians) are among the healthiest of people, noted for their activity and athletic powers, capable of defeating the choicest English players in their own favourite field game of cricket.

All this shows that the policy of gradually reducing the tariff on tea by continental Governments, and especially Russia, ought to benefit them. The same may be said of the Russian people in Europe and Asia, and there is no reason why tea should not be freely used all over the continent of Europe, and especially throughout the United States of America, while by no means causing loss to the revenue, but rather, eventually, benefiting it. There are some countries indeed—like the United States of America

—that consider it advisable to have no Customs levy on tea (except in time of war); and Belgium has lately led the way among the Powers of continental Europe in abolishing the duty on tea. But taking the case of Russia, for instance, a reduction of duty to the equivalent of 1s. per lb. could not fail to be beneficial, and still more, a few years later, if there were a further reduction to the equivalent of 6d. per lb., so making this very wholesome and refreshing beverage (tea) accessible to many more millions of the Russian people than it can be at present.*

I would mention further that the tea exported from Ceylon is noted for its purity and delicacy of flavour. It is all made by machinery, and very great care is taken in the various processes, and in the packing. The quantity of tannin is comparatively limited in Ceylon tea, but its presence in the infusion depends entirely on the time the tea is left in the boiling water before the extract is poured out. If only left four minutes very little tannin is extracted. Here are the instructions for making Ceylon tea:—

1. The water to be boiled should be *fresh and pure*, and as soft as procurable.

2. It should be boiled in a perfectly clean kettle, and not deemed to be boiling until the water throbs, and throws off steam *in profusion*.

3. First make the tea-pot hot, then pour into it the *freshly*-boiled water,—after this strew the tea—a tea-spoonful for each cup of tea—on the top of the water when it will *gradually* sink. In this way the tea leaves will not be scalded and the fragrance will be kept at its best. The water should be used as soon as it boils, and not allowed to become flat by over-boiling.

4. Maximum time of infusion to be five minutes.

5. The infusion (*not decoction*) should be decanted into another tea-pot, *first made hot for its reception*. Prepared in this way (if a "cosy" is used) tea will remain hot and pleasant *and wholesome* for more than *double* the time it would were cold tea-pots employed.

6. Do not use the spent leaves for a second infusion.

Attention may, in conclusion, be drawn to the appended list of the Customs duties imposed by different nations of the world:—

Approximate Duty on Tea (in Pence per English lb.) in Europe and N. America.

United Kingdom	6d.
United States of America	5d.†
Canada 10 p.c. (from producing country and U.K.—free).	
Russia	1s. $11\frac{1}{2}$d.‡
Austro-Hungary	9d.§
Germany	6d.*
Norway	$9\frac{3}{4}$d.
Denmark	$4\frac{1}{2}$d.
France	1s. 4d. to 1s. $6\frac{1}{2}$d.
Holland	$2\frac{1}{4}$d.
Belgium	Free.
Italy	$8\frac{3}{4}$d. to $11\frac{3}{4}$d.†
Spain	10d. to $11\frac{1}{2}$d.
Portugal	1s. $7\frac{1}{2}$d. to 1s. $11\frac{1}{2}$d.
Sweden	3d. to $4\frac{3}{4}$d.
Greece	1s. $1\frac{1}{2}$d. to 1s. 6d.
Roumania	$2\frac{1}{2}$d.
Switzerland	$1\frac{3}{4}$d.
Gibraltar	Free.
Malta	Free.
Cyprus	6d.
Turkey	8 per cent. *Ad valorem.*
Bulgaria	30 do. do.
Newfoundland	3d. + 14 per cent. do.

* This is also, of course, true of France and other European States with high duties on tea.

† 10 cents=5d.

‡ Duty on Tea in Russia is about 1s. $10\frac{3}{4}$d. per Russian lb. or roughly 2s. per English lb. 1 lb. English=1 1-10th lb. Russian.

§ Duty on tea in Austro-Hungary is 100 gold florins per 100 kilos. or about 9d. per English lb.

THE PRODUCTION OF AN ARTIFICIAL LIGHT OF THE SAME CHARACTER AS DAYLIGHT.‡

It is a matter of common experience that many colours alter in appearance when seen by artificial light. The extent to which colours may vary under different illumination is perhaps not commonly known, but is well illustrated by the range of dyed cloths exhibited. Amongst other patterns, one which is green by daylight becomes red-brown by gaslight; a violet changes to purple; a grey to heliotrope; a shade of tan to a brick-red. Particularly striking is a pattern woven from specially dyed yarns, which appears a uniform green colour by daylight, but which is figured by gaslight. Seen by the light of the electric arc, the patterns show similar but less marked changes.

It may be of interest to indicate briefly how such peculiar changes of colour arise. The colour of a body depends, in the first place, on the nature of the incident light. In monochromatic red light a red appears much the same as in daylight, but a yellow changes to red, a green is almost black, while blues and violets become red.

Gaslight shows a continuous spectrum from red to violet, but compared to daylight is of a strong orange colour due to an excess of rays in the red, orange, and yellow. It does not, however, necessarily result that all colours appear redder by gaslight. It is, indeed, well known that the majority of colours

* Duty on tea in Germany is 50 Pfennig a lb.=6d.

† The Government duty on tea in Italy is 2·50 francs per kilo=2s. or $9\frac{1}{2}$d. per lb. Besides this each town has its own town dues (*octroi*) and these vary according to the town, for instance, in Naples $4\frac{1}{2}$d. per lb. is charged, and tea entering that city has to pay a duty of about 1s. 2d. per lb.

‡ Abstract of a paper read before Section A of the British Association at Bradford, 1900, by Arthur Dufton, M.A., B.Sc., and Walter M. Gardner, Bradford Technical College.

change little by gaslight. This is due to the adaptability of the eye; if the light becomes redder the eye becomes less sensitive to red; if the light is deficient in green the eyes becomes more sensitive to green. Persons working by gaslight soon cease to notice its intense orange colour. It results that a grey produced by mixture of black and white appears grey under any illumination, and simple colours, such as reds, oranges, and some greens giving light confined practically to one part of the spectrum, undergo little change.

Generally, however, the colour of a body is due to a mixture of light from different parts of the spectrum. All violet colours are transparent, not only for violet but also for blue and red light; all blues transmit not only blue, violet, and green light, but also more or less red. Consequently, whenever a blue or violet is used in the production of what is called by artists a "tertiary" colour, the general result is a colour having bright bands in different parts of the spectrum. A mixture of red, blue, and yellow to produce a neutral grey will show bright bands in the red and green—complementary colours, resulting in a proportion of white light. According to the exact position and intensity of these bands the grey will become redder or greener or may even remain unchanged by gaslight.

Generally colours become redder under artificial light. This is due not merely to the redder character of artificial lights as compared with daylight, but to the peculiar transparency of colouring matters for red light. Among reds and yellows, we have many theoretically perfect colouring matters—a perfect yellow being one having sharp absorption in the violet and blue, and perfect transparency for green, yellow, orange, and red rays. A perfect blue would be transparent for violet, blue, and green, and opaque for the rest of the spectrum. Apparently such a blue can only be obtained by mean of cupric salts. All other blue dyes and pigments we have examined agree in being more or less transparent for red light. Even greens transmit some red. This peculiar transparency of colours for red light is of primary importance in colour-matching. All dyers know how persistent is the tendency to the development of red in the production of compound shades.

The need of an artificial light which should so closely resemble daylight as to show colours in their true relationship has long been felt by workers in colour. At present the electric arc light is largely used for colour work, but, as we have seen, it is far from satisfactory.

The peculiar character of daylight is due essentially to the modification produced by the atmosphere in the light from the sun. Light from a north sky as usually adopted for colour work is deficient in red, orange, and yellow rays, and consequently the light from a clear north sky is instensely blue.

Starting with the electric arc light as being nearest daylight in character, the authors attempted to imitate by direct absorption the effect produced by scattering in the atmosphere.

The light of an arc lamp consists of two distinct parts:—(1) The light from the glowing carbons; (2) the light of the arc itself, characterised by its richness in violet rays. In lamps of the enclosed arc type the length of arc is increased, and consequently such lamps give a light richer in violet rays. Although arc lights vary somewhat in the proportion of violet light, they all agree in being richer than daylight in the amount of red, orange, and yellow rays, compared with the amount of green and blue. Owing to the peculiar transparency of colours to red light already noticed, it is of primary importance that the proportion of red light should be carefully adjusted. Small variations in the amount of violet light are of minor importance, owing to the eye being less sensitive to such rays, and also because in mixing colours there is not the same tendency to develop a band of violet as we have seen occurs in the red, since yellow colours generally have complete absorption in the violet.

The required absorption of the less refrangible rays can be effected by means of blue cupric salts. A solution of copper sulphate shows strong absorption at the extreme red of the spectrum, the absorption extending with diminishing intensity into the green.

For practical purposes the light from the arc is modified by passage through pale blue glass coloured by means of copper. This coloured glass may conveniently take the form of a globe replacing the ordinary globe of the arc light.

A COMBINATION INTEGRATING WATT-METER AND MAXIMUM DEMAND INDICATOR. *

The paper fully sets forth the advantages of the maximum demand system of charging for the supply of electricity, and describes a new meter—the invention of Messrs. Barker and Ewing—to be used for this purpose. The paper was illustrated by diagrams, and examples of the meter were exhibited.

In charging for the supply of electricity it has become usual to make a distinction in the prices charged to those consumers who use a few lights for many hours per day and those who use many lights for an hour or less, for, although at the end of the year the number of units consumed may be the same in both cases, the cost to the company or corporation in machinery, mains, and every other charge will be in the ratio of the number of lamps lighted at one time. The consumer who uses a few lamps for many hours should be charged at a less rate per unit in view of the smaller capital expenditure which his supply involves.

The late Dr. Hopkinson advocated a system which takes account of this consideration in arriving at the fair price to be charged for current. In the system in question, now known as the "Maximum Demand System," the total quantity of electricity consumed

* Abstract of a paper read before Section G of the British Association at Bradford, by T. Barker.

in six months is measured in the usual way, and the greatest rate at which the consumer has been taking current is also recorded. If the consumer in the six months' period takes a smaller total than would correspond to one hour a day at the greatest rate of demand he is charged the full price per unit but if the total consumption exceeds this he is charged a reduced rate for each unit in excess.

The system has been used with marked success in some seventy-two towns. It has improved the load factor, and has enabled a large number of additional units to be sold without increase of station plant or mains. Until the introduction of Barker and Ewing's Demand Indicator it was necessary to use two meters —one to record the total number of units taken by the consumer and the other to show his maximum rate of demand.

The Barker and Ewing Indicator forms an integral part of the ordinary meter, and absorbs no energy; it further records watts and not amperes. With an alternating supply it shows actual watts and not apparent watts, an important difference in the case of motors and arc-lamps. It is not affected by any ordinary short circuit, its time lag being sufficient to prevent it coming into action. The Indicator may be used to show the actual rate of demand at any instant in place of recording the maximum rate of demand. In this form it is specially useful in switchboard instruments, showing the attendant the rate at which electric energy is passing through a feeder or s supplied from a dynamo at any instant. The meter also serves at the same time to integrate the total amount which has passed through that particular feeder or machine.

*MANCHESTER AND LIVERPOOL EXPRESS RAILWAY.**

A monorail line between Manchester and Liverpool has been projected by Mr. Behr to accommodate express passenger traffic alone between those two cities. The train, which is to be worked by electric power, will consist of only one coach, weighing 45 tons, and seating 64 passengers. Starting every ten minutes, and travelling at the mean rate of 110 miles an hour, it would do the distance of 34½ miles in 20 minutes. The fares will be slightly lower than those charged at present. There will be no intermediate stations, and no points or crossings. Hence signals will be needed only to secure a perfect block system of working the line. The monorail railway was projected by Latigue in 1882. We have only one example of this system of railway in the United Kingdom, viz., between Listowel and Ballybunion, in Ireland, nine and a quarter miles long, with one intermediate station—Liselton. There were 42 level and farm crossings. It was worked by steam, and the train consisted of a locomotive and four coaches. It cost £33,000 to build, or £3,060 per mile. When the author inspected the line in the early part of this year there had never been a Board of Trade inquiry into any accident, and the maintenance of the structure had been effective. The main principle of the system was the suspension of the coaches on a single elevated rail, so that their centres of gravity were below the rail. Each coach sits the rail like a saddle. The rail was fixed on trestles, which were tied and braced together, the tie bars being light rails against which guide wheels rolled. The Manchester and Liverpool Express is intended to be more massively and rigidly built. Derailment on such a structure is impossible, and curves of comparatively small radius can be passed with safety at high speeds. It is proposed to fix the generating station midway, at Warrington, and to transmit the electric energy at high pressure (10,000) volts to each terminal station. The speed which a train can acquire on a railway depends on the power that could be continuously applied at the tread of the driving-wheel. Electricity enables the engineer to apply instantaneously to light loads a power which steam could not supply. Hence speeds are possible with electricity which were unattainable with steam.

Mr. F. J. Behr discussed the brakes and signals for the Manchester and Liverpool line. The line would be divided into eight sections, and the train would automatically raise and lower the danger signals. There would consequently always be a clear run of over four miles for slowing down. The fitting of emergency brakes would appear superfluous, but arrangements had been made to pull the train up in 500 yards.

* Abstract of papers read by Sir William H. Preece, K.C.B., F.R.S., and by Mr. F. J. Behr, before Section G of the British Association, Bradford.

*THE SENSITIVENESS OF METALLIC SILVER TO LIGHT.**

The paper is a continuation of that read before the Royal Society on May 31st, and contains an account of further experiments on the production of visible photographic images upon plain silver surfaces by the action of solar radiations. The author has found that such visible images are formed when pure silver foils or silvered glass are exposed to sunlight in exhausted glass tubes, and, apparently, more readily in the presence of watery vapour. Invisible, but developable, images were readily obtained in exhausted tubes in which no signs of the presence of moisture were apparent. By prolonged exposure a visible change also takes place. When thin films of silver on glass have been fully exposed in sunlight the action has been found to penetrate the film and produce a distinctly visible image at the back as well as on the

* Abstract of a paper read before Section B of the British Association at Bradford, by Major-General J. Waterhouse, I.S.C.

face, the exposed parts appearing always lighter than the unexposed.

Fresh experiments with silver plates used as anode and cathode in a decomposition cell containing distilled water, through which a weak current was allowed to pass, showed that the pale grey deposit on the cathode and the dark olive yellow coating on the anode were both quite sensitive to light, and appeared lighter by exposure, in a manner somewhat analogous to that observed on silvered glass or plain silver foils exposed to light. It was noticed that the visible images were not dissolved away either by the usual photographic fixing agents, nor by dilute nitric acid.

A very curious action of light upon glass has also been observed. In this case a silvered glass plate was exposed for about a month under a cut-out screen of thin aluminium, the unsilvered side of the glass being in contact with the aluminium and not protected from the air by a covering glass plate. After exposure the plate was put aside for a few days with the exposed glass side in contact with the silvered surface of another piece of polished silvered glass, which was then found to have received an impressed image from the glass of the design cut out of the aluminium screen. The image was quite visible, clear and sharp, and somewhat similar to the images directly impressed by light, though it had not the same appearance of being bleached out, when examined by reflected light. Several days afterwards a second similar image was produced in the same way by contact with the glass upon another freshly polished silvered glass plate, and no doubt several more could be produced in the same way.

These new experiments seem to show that the images formed by the action of light upon plain silver surfaces are due more to molecular or physical changes than to chemical decomposition, though the latter may also probably come into play in the presence of watery vapour, or other conditions favouring oxidation and reduction of the metallic surface. The author is continuing the investigation.

ESPARTO GRASS TRADE.

Reports from the British Vice-Consul at Tunis and the Acting British Consul-General at Algiers, with reference to the diminished supplies of esparto grass, have been received, and published in the *Board of Trade Journal.*

The Vice-Consul in Tunis writes:—"The extremely low price paid for esparto grass in England renders it almost impossible for the Arabs to pluck and bring down the esparto from the mountains to the coast at any profit to themselves. The present price in England is, I believe, £3 per ton, whereas several years ago £12 was paid per ton. When the barley harvest is good it is much more profitable to the Arabs to work in the barley fields than to gather esparto, which grows on the mountains at some distance from the coast, and the transport of which swallows up nearly all the profits resulting from its sale on delivery on the coast. Even when the esparto has been gathered, and the harvest is over (generally in September), it often happens that the Arabs prefer to leave their crop in the mountain sooner than incur the risk of losing money in the transaction. There have been no political troubles in the esparto district, and the military situation in no way affects the supply of grass from the esparto district."

The Acting British Consul-General in Algiers writes:—"The esparto business in Algeria is largely confined to two areas—the Philippeville and Bougie district and the Department of Oran. The reasons which dictate the poverty of the esparto crop this year are different in the two areas. To deal first with the Bougie and Philippeville district, I would ascribe the failure of the harvest chiefly to the difficulty of getting labour to pluck the grass on account of the barley harvest. This should be taken in connection with the great fall in the market price of esparto grass during the last fifteen years. The following considerations of price will prove the justice of this conclusion:—The sum at present paid for the grass delivered free on board is 5·75 francs to 6 francs per 100 kilogrammes, about half what it formerly was. The vendor is, therefore, obviously unable to pay what he formerly paid for plucking. At the present moment wages for plucking and tying up into small bundles are 1·50 francs to 2·50 per diem, according to the position of the fields, which means a starvation wage of about one franc a day to the labourer. In years like the present, when the barley harvest is good and good wages obtainable, it is impossible to obtain labour in the alfa fields at this price. It is however probable that, should British merchants be willing to pay an additional franc per 100 kilogrammes, the dealers in the Philippeville and Bougie district would be enabled this year to provide 10,000 tons of grass. There are, moreover, two points to which attention should, I think, be called, especially in connection with the esparto - producing area now under consideration. The first of these is the exhaustion of the fields due to continuous plucking, which necessitates more distant centres being worked, with consequent increase in the expenses of transport. The second point affects the mode of delivery. It is at present the custom for British merchants to require delivery to be effected in the United Kingdom, payment to be according to weight and quality as found there. The absence of regular communication with the United Kingdom makes this often a matter of considerable difficulty, besides the fact that the Algerian vendors, who are generally in a small way of business, and cannot afford the expense of an agent in the United Kingdom to represent them, are compelled to employ a broker at the port of discharge to superintend the weighing out of the cargo – an inconvenient and unsatisfactory arrangement. English buyers are, therefore, strongly recommended to have an agent to re-

present them at the port of loading, who would, for a small commission, look after their interests and make all necessary arrangements. With reference to the second area to which I have alluded, namely, the Oran district, the paucity in the esparto harvest should, I think, be ascribed chiefly to the political troubles and military situation in Southern Algeria. The excellence of the barley crop may also have produced a certain effect. To ensure transport arrangements for the forces *en route* for Igli, many of the up-country tribes were requisitioned by the military authorities, and were, therefore, unavailable for the alfa harvest. Moreover, a very large number of transport camels died in the course of the expeditions, and diminished to a considerable extent the means of carriage. It is, however, to be hoped that, should no further military movements take place this autumn the military authorities will see their way to granting further permissions for the plucking of the grass, and that towards the end of the season (November) larger supplies may be forthcoming. It is further worthy of mention that competition among buyers in Oran is very keen this year, and, as nearly all of them are engaged for forward delivery, some are paying up-country a higher price for grass than the market value in England warrants. Supposing this to continue, the Arab labourers will earn the money they require by making less grass, and it is difficult, if not impossible, to get them to work longer than suffices for them to earn the amount which they are in need of, and for which they have come to work."

*COMMERCIAL RESOURCES OF TROPICAL AFRICA.**

At least 70 per cent. of the total trade of Africa falls to the countries of the extreme north and south, leaving the whole Tropical Africa, with an area of some 9,000,000 square miles, a total trade of at most £30,000,000, of which nearly 7,000,000 belongs to the small islands of Mauritius and Réunion. The object of the author is to examine the causes of this small commercial movement as compared with that of other tropical countries, and to form some conclusion as to the permanence, or the reverse, of present conditions.

Among historical reasons for the smallness of the existing trade are (1) the attraction exercised during the age of great discoveries in America and the East and the consequent neglect of Africa; (2) the political condition of the African peoples; (3) the effects of the slave trade; while geographical causes are found in (1) the massive form of the continent and consequent absence of natural means of communication; (2) the unhealthiness of the coastlands. That many of these causes are not necessarily permanent is shown by a comparison with Brazil, which affords a close parallel with Tropical Africa in many respects. This shows that, given natural resources capable of supporting an increased export trade, the commercial future of Tropical Africa need not be hopeless.

The resources of a new country may be classed as (1) exhaustible, principally minerals; (2) permanent, chiefly animal and vegetable products, the second group being the more important. It may be again subdivided into (1) jungle products, which, though not necessarily exhaustible, are likely to suffer diminution; (2) cultivated products. The former may, under cultivation, be transferred to the latter sub group, which is the most important of all. In Brazil, *e.g.*, the vast preponderance of the exports is made up by the four products coffee, sugar, tobacco, and cotton. Rubber and timber, at present jungle products, and cacao, make up the seven principal resources of Brazil. In Tropical Africa jungle products, principally rubber and palm-oil and kernels (total annual value over £4,000,000), are at present those on which the export trade mainly depends. A period of development of plantation products has, however, set in, and coffee, cacao, cotton, tea, &c., have been grown with success in various parts. The chief difficulties to be encountered arise from (1) want of means of transport; (2) scarcity of labour; but these are now in a fair way to be overcome. The modern tendency for each country to depend for tropical produce largely on its own colonies must favour the commercial development of Africa, while the comparatively low population of Africa per square mile renders it probable that it will in the future play an important part in providing a food supply for the more thickly peopled continents.

* Abstract of a paper read before Section E of the British Association at Bradford, by Edward Heaton, M.A.

General Notes.

THE WORLD'S LARGE TELESCOPES.—In his Presidential Address to the Department of Astronomy of the British Association, at Bradford, Dr. A. A. Common, F.R.S., the chairman of the department, gave the following list of large telescopes in existence in 1900. He enumerates 28 refractors of 15 inches and upwards:—Paris (Exhibition), 50 in.; Yerkes, 40 in.; Lick, 36 in.; Pulkowa, 30 in.; Nice, 29·9 in.; Paris, 28·9 in; Greenwich, 28·0 in; Vienna, 27·0 in.; Washington, U.S., 26·0 in.; Leander, McCormick Observatory, Virginia, 26·0 in.; Greenwich, 26·0 in.; Newall's, Cambridge, 25·0 in.; Cape of Good Hope, 24·0 in.; Harvard, 24·0 in.; Princeton, N.J., U.S., 23·0 in.; Mount Etna, 21·8; Strassburg, 19·1 in.; Milan, 19·1 in.; (Dearborn) Chicago, 18·5 in.; Warner Observatory, Rochester, U.S., 16·0 in.; Washburn Observatory, Madison, Wisconsin, 15·5 in.; Edinburgh, 15·1 in.; Brussels, 15·1 in.; Madrid, 15·0 in.; Rio Janeiro, 15·0 in.; Sir William Huggins, 15·0 in. Paris, 15·0 in. There are nine reflectors of 2 ft. 6 in. and upwards:—Lord Rosse, 6 ft.; Dr. Common, 5 ft.; Melbourne, 4 ft.; Paris, 4 ft.; Meudon, 3 ft. 3 in.; South Kensington, 3 ft.; Crossley (Lick), 3 ft.; Greenwich, 2 ft. 6 in.; South Kensington, 2 ft. 6 in.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

EXAMINATIONS FOR 1901.

The Examination Programme for 1901 is now ready, and can be obtained on application to the Secretary. The price (post paid) is 3d.

For some time past the addition to the Examinations of an Elementary Grade has been pressed upon the Council, and they have therefore added such a grade to the system of Examinations. Particulars about it have already been published in the *Journal* (see *Journal* for the 15th June), and will be found in the Programme. The Council have also in contemplation the addition of a Higher Grade, but the arrangements for this are not complete, and no examination in it will be held in 1901.

The Elementary Examinations in Languages will be dropped, their place being taken by the new Preliminary Examinations. The Examination in Domestic Economy will also be discontinued. The practice of recommending special text-books has been abandoned, except for certain subjects where the information seems to be necessary. Certain alterations have been made in the form of the present year's Programme, which, it is hoped, will make it more convenient for reference.

The standard for the General Grade (Grade II.) will be the same as that of the existing examinations of the Society, and the regulations will generally be the same as those previously in force, except that, in addition to the certificate granted in each subject, a Certificate of Proficiency in Commercial Knowledge will be issued to any candidate who has passed in the following five subjects within a period of three years:—(1) Arithmetic, (2) Book-keeping, (3) Précis-writing, (4) Shorthand, (5) a modern language.

The examination in the Preliminary Grade (Grade I.) will be adapted to the attainments of the genuine continuation school pupil who, after reaching Standards VI. or VII. in an elementary school (age 11 or 12), goes for two or three years into an evening continuation school. There is, however, no limitation of age.

Pass Certificates will be given in each of the subjects enumerated. In addition, a certificate of Proficiency in Elementary Commercial Knowledge will be given to any candidate passing in the following four subjects within a space of three years:—(1) Handwriting and Correspondence, (2) Shorthand, (3) Elementary Book-keeping and Office Routine, (4) Commercial Arithmetic.

Every pupil, before he is given his Certificate of Proficiency, will be required to produce such evidence of general education as that he has been in Standard VI., or has gone through the Third year course of a Higher Elementary School, or has passed the lowest grade of the examination of the College of Preceptors or the Preliminary Local Examinations, or otherwise has reached such a standard of general education as may appear satisfactory to the Council.

Examinations will also be held in the following optional subjects:—(1) Commercial History and Geography, (2) Preliminary French, (3) Preliminary German, (4) Elements of Typewriting.

In both Grades all the subjects in which the candidate has passed will be endorsed on the certificate. Candidates having once obtained the certificate, and passing in additional subjects within the stated period, can have these additional subjects endorsed on their certificate.

The Fees will be:—In Grade II., as now, 2s. 6d. for each subject, and 2s. 6d. for the Certificate of Proficiency. In Grade I., 2s. for each subject, and 2s. for the Certificate of Proficiency.

The dates of the Examinations will be March 18 to 21 inclusive, 1901.

Miscellaneous.

REPORT OF SCREW GAUGE COMMITTEE OF THE BRITISH ASSOCIATION, 1900.*

This committee was appointed at the Ipswich meeting of the British Association in 1895, to consider repeated complaints that screws of the British Association

* Report of a committee, consisting of Sir W. H. Preece (Chairman), Lord Kelvin, Sir F, J. Bramwell, Sir H. Trueman Wood, Major-Gen. Webber, Col. Watkin, Messrs. Crompton, A. Stroh, A. Le Neve Foster, C. J. Hewitt, G. K. B. Elphinstone, E. Rigg, C. V. Boys, J. Marshall Gorham, and W. A. Price (Secretary), appointed for the purpose of considering whether the British Association form of thread for small screws should be modified, and, if so, in what direction. For previous reports see *Journal*, vol 32, p. 115, vol. 33, p. 1016, vol. 47, p. 808.

thread, proposed by the committee of 1882, obtained commercially, were not satisfactorily interchangeable. It was evident that the difficulty arose from the want of proper gauges, or other ready means of testing screw threads, and the committee at once took steps to find out how these could be obtained. In a report presented at the Dover meeting of the Association of last year (1899) were described the efforts we had made to secure the production of these gauges, and to make then generally available in a commercial way. We reported that a high degree of accuracy in dimensions, though not in form, had been attained in a small number of specimens submitted to us by the Pratt and Whitney Company; that these were the product of exceptional skill and care; and that they were only obtained after long delay. These gauges were sufficiently good for all practical requirements, and had gauges of the same character been generally available some years before, it is probable that the complaints which led to the appointment of this committee would never have been made. Taking into consideration the difficulty that had been met in obtaining these gauges, the representations made by the manufacturers of the difficulty in producing them, and of the comparative ease with which a flat-topped thread can be accurately formed, and the fact that such screws are used in foreign countries for the best class of engineering work, we reported that the form of the British Association thread was unsatisfactory, and recommended that the committee should be reappointed to consider its modification.

A proposal to alter the form of an established and generally satisfactory system of screw threads may cause some apprehension among users of them, and the committee, many members of which are intimately acquainted with the trouble and inconvenience incidental to a change of the kind, recognise that very substantial reasons are required to justify it. They think it desirable that the considerations which have led them to make this proposal should be fully stated.

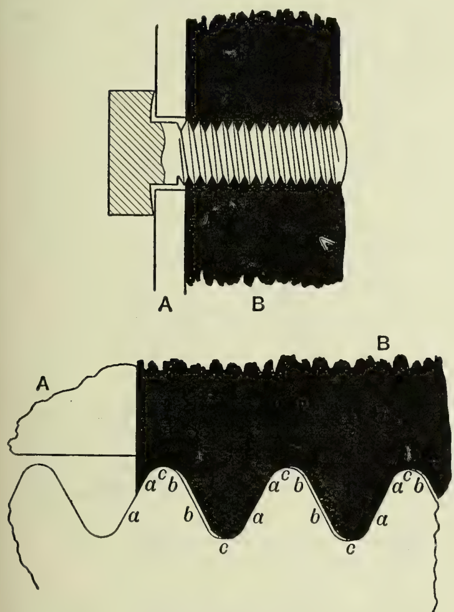
Consideration of the exact cause of the difficulty found in the construction of gauges for the British Association thread showed immediately that it was due to the rounded top and bottom of the thread. There is no difficulty in making any given angle between the straight portions or sides of the generating tool or chaser, but to arrange that these straight lines shall, at definite points, turn smoothly into circular arcs of a given radius is a matter of some difficulty. The difficulty has been met with a good deal of success. The original threads, cut by Mr. Lehmann, and those produced recently by the Pratt and Whitney Company, are admirable specimens of workmanship, especially when the small size of the pieces is considered; and to the careful work done by Mr. Lehmann in the years following 1882, when originating the threads, the success they have achieved is largely due. The production, however, of chasers, even if it can be repeated indefinitely, does not end the difficulty. The hardening of the screws produced by these tools introduces some inaccuracy. They are no longer perfectly straight, perfectly cylindrical, or of perfectly accurate pitch, and the only way to correct them is by grinding. The inaccuracies produced by hardening are not of sufficient importance to affect the use of taps, and in the case of die plates, the errors produced in the diameters are corrected by opening or closing the die; but for gauges corresponding to modern ideas of mechanical accuracy, the errors produced by hardening are considerable, and much greater than those found in screws whose forms can be finally obtained by grinding. With the British Association thread this process does not seem to be practicable except perhaps in single specimens, and in this lies the inherent defect of the thread.

A way out of the difficulty is offered by the adoption of a flat-topped thread, but before this can be discussed it is necessary to consider what are the peculiar advantages of the rounded thread, which have brought it into general use, and led to its adoption by the original committee. The British Association thread was taken with a slight modification from Professor Thury's Swiss system, which had been constructed by finding a formula to represent the average existing practice among Swiss clockmakers. Sir Joseph Whitworth formed his system of screws in a similar way by averaging the English engineering practice of his time. It appears that the object in view in both these cases was to regularise existing practice, not to effect a reform; and that an alteration in the form of thread in common use was not contemplated. The same was done in America for the United States thread, so far as the pitches and diameters were concerned, but the form of the thread was determined by Dr. Sellers on general considerations. The origin of the round thread in the British Association system was in the common practice of the Swiss workshops when the rule was constructed. Now whatever may be the prescribed shape of the thread, it is certain that small screws, produced on screw machines, will have rounded tops, and if a new rule for American threads were constructed from the shapes of ordinary small screws found in the United States, the form obtained would have a rounded top, notwithstanding that they are all supposed to represent the flat-topped Sellers thread. Since a screw machine tends to produce rounded threads, and the natural course of trade conditions tends to the reproduction of current forms, the common use in Switzerland of screws with rounded threads does not necessarily show that such a form has especial merit, or had originally been deliberately designed. It may be only the result of working conditions. Professor Thury, in defining his thread, chose a form which could be easily produced with fair accuracy, is perfectly efficient, and can be conformed to in practice, but we venture to think that it fails to meet other important conditions.

To ascertain the conditions which should determine the form of a screw thread, consider the mode of action of a screw holding two pieces together. In Fig. 1 the screw serves to hold the plate, A, to the solid

part, B, and a small part of the thread is drawn on a larger scale below. The action of the screw depends on the tensile strain due to the pressure produced over the surfaces *a a*, *a a* . . ., and the compression produced there by the act of screwing up relieves any pressure over the surfaces *b b*, *b b* . . . Contact and pressure at the points *c c c* . . ., depend on the relative diameters of the screw and the tapped hole. The spaces shown in the figure along the surfaces *b b*, *b b* . . ., are of course greater than would occur in a well-fitted screw. Now if the thread may be looked upon merely as a means of supporting the tensional strain on the bolt, without offering much frictional resistance to screwing up, it is clear that this will be most efficiently done if the pressure is evenly supported over the whole of the working surface of the thread *a a*, *a a* . . ., and within the assigned dimensions of the thread this surface should be as large as possible. Contact and

Fig. 1.



pressure at the points *c*, *c* . . ., depending on the respective diameters of the screw and the tapped hole may interfere with the fair contact of the working surfaces, involve extra resistance to screwing up, and so far as the support of the tensional strain is concerned serve no useful purpose. The best design for the thread in view of its function of supporting the tension is that which secures most perfectly a continuous working contact over the surface *a a*, *a a* . . ., and freedom from pressure at other points. These conditions are met best by a thread having straight sides, a flat top, and a clearance space at the top and bottom of the thread, such as is shown in Fig. 2. The provision of straight sides gives a form to the originating tool which can be produced with more ease and accuracy than one of a curved form, and assists to secure correspondence between the surfaces of the screw and nut; the provision of a flat top gives the largest possible area to the working surface within the given limits of the thread; the provision of a clearance space at top and bottom removes the possibility of any interference with the fit of the working surface by irregularities of form at those points, and avoids unnecessary friction. Screws with straight sides and flat tops are perfectly satisfactory in instrument practice, are employed in France and Germany for the most important engineering work, and are universal in America for work of all kinds, for instrument work as well as heavy engineering work. We understand that the provision of clearance is well recognised in the practice of American and French engineers, who use the Sellers thread, and Mr. Hewitt, at Prescot, gives a very liberal clearance in the screws manufactured by him. The ease with which such threads are originated is a point in their favour, though it would be of small importance if it were shown that the thread is practically defective in other ways.

As regards the reduction of the sectional area of the core by the proposed deepening of the thread, the figures obtained by Messrs. Gorham and Price, corroborated by common experience, show that screws give way under tension by breaking across the core rather than by stripping their threads or those of the nuts, and it has been urged against the proposal to deepen the thread, that it weakens the screw in its already weakest part. The reply to this is that the strength of the screw is really determined by the strength of the core, and that the British Association series is so closely spaced that a screw can always be found whose core is of the required size. Moreover, in well-designed work, screws have so large a factor of safety that a reduction of the section of the core by an amount, varying from 8 per cent. in large screws, to 12 per cent. in small screws, will not generally be a matter of great importance, though it will be remembered that the resistance to torsional fracture varies inversely as the square of the sectional area.

The adoption of a flat-topped thread with a clearance would, we believe, completely obviate the difficulty of producing satisfactory gauges, the question to which the attention of this committee was originally directed. The construction of these is referred to later in the report. Other elements of the screw have received the attention of the committee as follows.

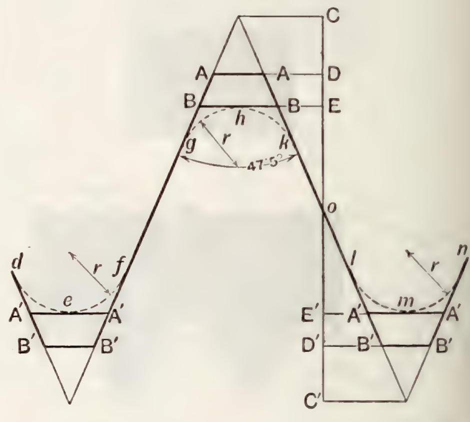
Mr. George M. Bond, of the Pratt and Whitney Company, has expressed to the committee a strong opinion that the angle of 60° employed in the Sellers thread is most suitable for screws because of the ease with which it is formed. Tools can be ground without difficulty, and with great accuracy, to any desired angle, and Mr. Bond's reason appears to the committee insufficient of itself to justify a change in practice. Considering, however, the extent to which screws of the Sellers form are employed in foreign engineering work, the committee desired to obtain

some evidence of the exact value of the particular angle of 60°, since if this angle were found to possess a great advantage over the angle of $47\frac{1}{2}$°, the adoption of the Sellers thread would have the additional recommendation of bringing the small screw practice into line with an already extensive engineering practice, while giving effect to the conclusions already reached by the committee of the desirability of clearance and a flat-topped thread. Some experiments on lines suggested by Mr. Crompton have been carried out by Messrs. J. Marshall Gorham and W. A. Price, and their results are printed as an appendix to this report. They concluded that an angle of $47\frac{1}{2}$° is better for screws than an angle of 60°, on the ground that it offers much less frictional resistance to screwing and unscrewing on a given tensional load, and the general tendency of this observation is corroborated by the practice of using a thread for the leading screws of lathes, the screws of carpenters' clamps, and of screw jacks, in which the working surface is perpendicular to the axis of the screw. Another consideration leads us to think it undesirable to adopt an angle of 60°. The advantage of bringing small screw-practice into line with that of foreign engineers will only be fully gained if their rule for the size of the flat top of the thread is also adopted. This rule gives a maximum possible clearance of ·108 pitch when the thread is cut to a perfectly sharp V at the bottom. This clearance would be sufficient, but tools with perfectly sharp points are maintained with difficulty, and it would not generally obtain. A tool of $47\frac{1}{2}$°, ground to give a clearance of ·1 of the pitch, has a flat at the point one-seventh of the pitch wide. For small screws Professor Thury's angle of $47\frac{1}{2}$° had the same sanction of practice among clockmakers as a larger angle had among engineers when it was adopted by Dr. Sellers, and though it is often difficult to assign exact reasons for the particular practice of practical men, yet it cannot be disregarded unless the reasons for its use are quite clear and are shown to be insufficient. We see no sufficient reason to change the present angle of $47\frac{1}{2}$°, especially as a change of angle would make existing stocks and tools altogether useless in conjunction with the existing form.

The existing series of pitches and diameters with their designating numbers is generally approved, and the committee has received no suggestion that it is otherwise than satisfactory.

Thus far it has been assumed that given the necessary tools all forms of thread can be produced with the same ease. This, however, does not apply to the small screws used in watches, which are produced by turning the blanks into a hard die without cutting edges. In such a process great force would be required either to squeeze the metal into sharp re-entrant angles, or to make it flow past sharp corners. On this point Mr. C. F. Hewitt writes to the committee respecting the proposed alteration of the British Association thread :—" A die of this operating character for screws flatted top and bottom soon loses its contour and needs constant replacement; and in addition my experience leads me to believe that it requires more force than a rounded thread, therefore it sets up more torsional strain of the metal a factor of great moment where such small diameters are being produced; breakage in the dies being a constant source of trouble even at the best." In the same letter Mr. Hewitt explicitly approves of the proposals of the committee for the larger threads, both as regards the flat top and the provision of clearance. Mr. Hewitt's experience at the Prescot watch factory is so large, and his knowledge of the manufacture of watchmakers' screws is so intimate, that the other members of the committee have no hesitation in accepting his suggestion to divide the present series into two sections. The large section, consisting of what may be called instrument-makers' screws, from No. 0 to No. 11, includes screws from 6 mm. to 1·5 mm., or in English measure from $\frac{1}{4}$ inch to ·059 inch. The small section, from No. 12 downwards, consisting of watchmakers' screws, includes screws below 1·5 mm., or in English measure below ·059 inch. The committee propose to modify the form of thread of the screw of the large section only.

FIG. 2.



The above considerations lead the committee to propose to replace the present form of thread of screws from No. 0 to No. 11 inclusive by the form shown in Fig. 2.

Here the line *A′ A A* . . . represents the outline of the nut *B′ B B* . . . of the screw; and *d e f* . . . is the outline of the present British Association thread. It will be observed that the flat part of the side, or the working surface, is increased by nearly 60 per cent. Accurately formed screws of this pattern for special purposes can be cut on the lathe with much greater ease than those with a rounded thread. The screw is cut with a single-point tool from a cylinder, and in the larger sizes the nut can be cut with a single-point tool from a cylindrical hole. The difficulty of forming chasers of a complicated form is entirely avoided. These observations apply equally to the construction of taps and plates, and of gauge pieces. Given that

the pitch of the screw and the angle of the thread are accurate, and the sides straight, the fit of the screw in a correct gauge is determined by the length of the diametral line terminated by the inclined sides of the thread, and this dimension called *the effective diameter of the screw.* If this dimension is the same in the screw and the nut they will fit without shake independently of the exact values of the external and internal diameters, or of the exact form of the ends; and the lengths of the effective diameters of screws and nuts are definite numerical measures of their fits one with another. The point which it is important should be right is the straight between A′ and B in both nut and screw. The nut must not pass A′, nor the screw pass B; but so long as the nut is cut as far as B or farther the shape of the excess does not matter. The same thing holds with the screw at A′, but here excessive clearance is objectionable because it weakens the core of the screw.

In constructing plug-gauges for testing nuts the straight sides of the thread can be corrected after hardening by grinding with a lap, and this process corrects at once the irregularities of pitch and angle, and is continued till the effective diameter is reduced to the desired value. The top of the thread, being cylindrical, presents no difficulty. The form of the bottom of the thread is immaterial, since the clear hole in the nut is most conveniently tested with a cylinder plug gauge. In the specimens submitted to us last year by the Pratt and Whitney Company this cylinder was constructed in one piece with the screwed plug.

In ring or nut gauges for testing screws a slit is cut through the tapped hole, and closed with a screw. The hole can be polished by a corresponding screwed piece, but could only be corrected by grinding by the use of very refined appliances. After polishing the slit is closed to fit a prepared screwed plug, and the clear hole brought to its correct value with a lap. The process is not so satisfactory as with a plug-gauge, but the pieces which the ring is designed to test can be satisfactorily measured in other ways, so that the gauge is of less importance.

The effective diameter of a screw is readily measured in a micrometer gauge between a conical point and a **V** notch, both having an angle of $47\frac{1}{2}°$. An instrument of this kind constructed for 60° is figured in tool makers' catalogues.

Ordinary taps for nuts or for the working holes in larger pieces will be different in form from the screws, and different from the taps employed to make dies or screw plates. The ordinary dies or plates in a workshop used for making screws will not be suitable for making taps. In small workshops this may sometimes cause mistakes, but in shops having a separate tool-room this extra specialisation should present no difficulty.

Objections have been raised to the above proposal on three grounds.

It has been represented to us that in finely fitted work the screws should fit their holes perfectly and all over, and that the existence of a clearance gap all round the edge of the thread is inconsistent with a high standard of workmanship. This objection is evidently to some extent a matter of opinion, and it is always possible to use taps of the same form as the screws, so that the screws will fit the taps all over as in a non-clearance system.

It has been objected that the introduction of the proposed system will seriously interfere with existing stocks of screws and the repairs of existing instruments. In Fig. 2 it is shown that the new thread differs from the old one by the addition of the small corners, *gBh*, *hBk*, to the screw, and *dA′e*, *eA′f*, to the nut. In making screws and nuts with dies and taps, these corners will always be rounded off to some extent, though the re-entrant angles at *A B′* will be as sharp as the tool which makes them. In some screws and nuts prepared experimentally to test this point, the outer edges of the thread were fairly rounded, and they were perfectly interchangeable with the B.A. screws of an existing manufacturer's stock. The committee believe that screws made to the proposed new thread will, owing to the inevitable rounding, be interchangeable with existing stocks in a great majority of cases, and that only in cases where great care has been taken to work closely to the old standard will any difference be noticed.

It has been objected that the proposed thread is unsuitable for such work as bicycles and small arms which are subject to violent concussion and vibration, whereby the screws are liable to be shaken loose and to drop out, and the case of alternating current arc lamps has been mentioned to the committee as one in which the same thing is liable to occur. Mr. O. P. Clements, of the Birmingham Small Arms Company, contributes a paper to the Mechanical Section on the practice of his firm in the manufacture of screws for bicycle parts, for which it is found necessary to use rounded threads fitting very closely all over. It is clear that no one form of thread can be suitable for all purposes, and we have direct evidence that the form of thread we propose does not fail in instrument work in the way Mr. Clements anticipates that it would do in bicycle work.

We beg to report that the system of screw threads recommended by the British Association for the use of instrument makers, and known as the British Association screw threads, should be modified in the following way for all screws from No. 0 to No. 11 inclusive.

For Screws.—That the designating numbers, pitches, outside diameters, and the common angle of $47\frac{1}{2}°$ remain unchanged; but that the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch, the diameter of the solid core being, in consequence, diminished by one-fifth of the pitch.

For Nuts.—That the designating numbers, the pitches, the diameters of the clear holes, and the common angle of $47\frac{1}{2}°$ remain unchanged; but that

the top and bottom of the thread shall be cylindrical, showing flats in section, and that the depth of the thread shall be increased by one-tenth of the pitch.

The appended Table gives the pitches and diameters of the different threads modified in accordance with this recommendation.

Table of the pitches and diameters of the British Association thread under the rule proposed above.

No.	Pitch.		Screw.				Nut.			
			Outside diameter.		Inside diameter.		Outside diameter.		Inside diameter.	
	Millimetres.	Mils.	Millimetres.	Mils.	Millimetres.	Mils.	Millimetres	Mils.	Millimetres.	Mils.
0	1·0	39·4	6·0	236·2	4·6	181·1	6·2	244·1	4·8	189·2
1	·9	35·4	5·3	208·7	4·04	159·1	5.48	215·8	4·22	166·2
2	·81	31·9	4·7	185·0	3·566	140·4	4·862	191·4	3·728	146·8
3	·73	28·7	4·1	161·4	3.078	121·2	4·246	167·2	3·224	126·9
4	·66	26·0	3·6	141·7	2·676	105·4	3·732	146·9	2·808	110·6
5	·59	23·2	3·2	126·0	2·374	93·5	3·318	130·6	2·492	98·1
6	·53	20·9	2·8	110·2	2·058	81·0	2·906	114·4	2·164	85·2
7	·48	18·9	2·5	98·4	1·828	72·0	2·596	102·2	1·924	75·7
8	·43	16·9	2·2	86·6	1·598	62·9	2·286	90·0	1·684	66·3
9	·39	15·4	1·9	74·8	1·354	53·3	1·978	77·9	1·432	56·4
10	·35	13·8	1·7	66·9	1·200	47·6	1·77	69·7	1·280	50·4
11	·31	12·2	1·5	59·1	1·066	42·0	1·562	61·5	1·128	44·4

In order to give practical effect to our recommendations we desire to obtain a set of the proposed screws, with tools and gauges, for comparison with the present ones. We shall thus be able to exhibit, in a concrete form, the character of the thread, and also to show how far screws with the new tools are interchangeable with the existing stocks. We recommend that the committee shall be reappointed for this purpose.

APPENDIX.

Report of Experiments on Screw-Threads made by J. Marshall Gorham and W. A. Price.

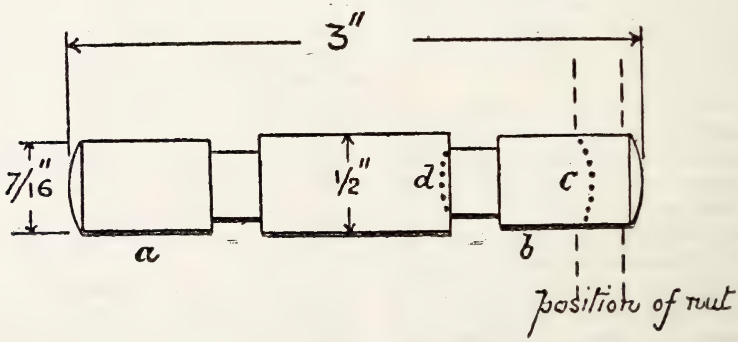
The object of these experiments was to determine the relative advantages of different angles for the threads of small screws, and two questions were proposed for trial.

1. Which angle gives the greatest frictional torque to resist unscrewing?

2. Which angle gives the greatest resistance to the tearing of a steel screw out of a brass plate or nut?

To answer these questions, six pieces, of the form of Fig. 3, were made of steel. On one end, *a*, of each a thread was cut which was the same in every case, and was used only for the purpose of connecting the pieces in the testing-machine. The threads to be compared were cut on the ends *b*. Three kinds of threads were tried, two pieces being made of each kind of thread.

FIG. 3.



The mode of trial is shown in Fig. 4. A pair of these steel pieces, A A, having threads of the same kind at the ends *b b*, were tightly screwed by the ends *a a* into a sleeve F, so that they could not be unscrewed by the forces employed in the test. On the ends *b b* were placed brass nuts B B, supported on steel collars C C, which rested in spherical seats in the brass pieces D D. The last pieces D D were

screwed into E E, the cast-iron terminal blocks of the testing machine. Two experiments were made in each case.

1. With a steady pull on the specimens the torque required to turn both screws simultaneously in their nuts was measured. This was ascertained by means of a small spring balance acting by a lever on the hexagonal sleeve F.

2. The pull of the testing-machine was then steadily increased until one of the screws was pulled through the nut.

The screwed pieces A A were turned out of tool steel, bright drawn rods of clockmakers' silver steel, ½″ diameter. The main object of the experiments being to find the force required to shear the thread out of the nuts B B by screws of given form, any deformation of the screw itself had to be avoided. The *b* ends of the steel pieces were accordingly water-hardened and let down to a spring temper. In the course of testing, one out of each pair of steel screws broke at the point where it entered the brass nut, at a strain much below the calculated breaking strain. The form of the fracture was in every case that of the dotted line *c*, shown in Fig. 3. Professor Unwin, to whom this point was submitted, supposes that this has no bearing on the strength or weakness of the particular forms of thread used, but was due to internal strains in the steel produced by the water-hardening, and to a slight bending force acting with maximum effect at the point where the screw enters the nut. The spherical seats of the collars C C will not, he points out, wholly prevent the occurrence of this force. He suggests that had the screws been hardened in oil this probably would not have happened. The sectional area of the cores of the screws was ·095 square inch, and the breaking strain was expected to be about 13,500 lbs. Those that broke where they entered the nut broke at 5,600 lbs. (60° screw), 5,860 lbs. (50° screw), and 5,330 lbs. (40° screw) respectively. In a subsequent test one of them broke along the line *d* (Fig. 3) at 10,280 lbs. Fortunately, in every case a sufficient length of the screw was left after the accident to put on anothe nut, and in each case a satisfactory result was obtained in a subsequent trial, the screws being drawn through the nuts without being themselves broken.

The forms of the screws tested are shown in Figs. 5 and 6, p. 812. The diameters, both at the top and the bottom of the thread, were the same in all the screws, and also in all the nuts. The screw threads were in all cases flat-topped, with slightly rounded, but nearly flat, bottoms. The pitch of the screw was the same in every case, 16 to the inch. The three threads had angles respectively of 40°, 50°, and 60°. Each screw was cut with a single point tool, ground to the correct angle from a cylinder previously turned to the correct diameter. The nuts were cut with single point inside turning tools, also accurately ground, in a cylindrical hole previously bored to the correct diameter.

The outside diameter of each screw was $\frac{7}{16}$ inch (·4375), and the inside diameter of each nut was ·3575 inch. A clearance of ·005 inch was given at the top and bottom of the thread in every case.

Fig. 4.

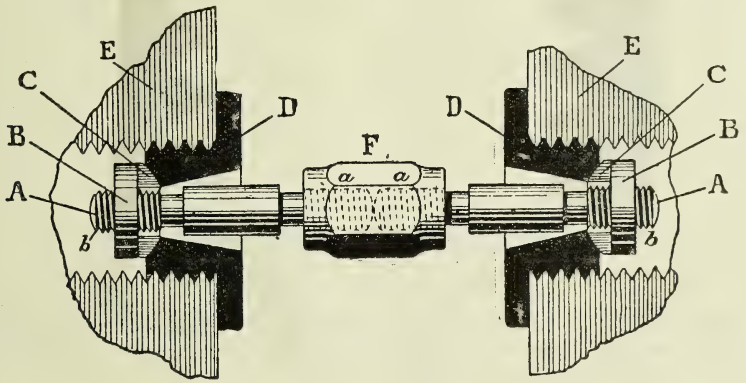


Fig. 5 shows the form of the screw and nut, having an angle of 40°, and the dimensions which are figured are the same in each of the other two cases.

Fig. 6 gives the outline of the contact surfaces of the screw and nut in each of the three cases. In this figure the dimensions are figured in thousandths of an inch.

The dimensions employed for these screws were chosen as sizes, which, while not extravagantly outside those of the screws to which the data are to be applied, provide quantities convenient for measurement with a micrometer gauge, and for the testing-machine.

The following results were obtained :—

A.—Torque required to turn a pair of the screws in two nuts, each ·226 inch thick (3·6 threads) drawn apart with a strain of 1 ton.

Angle of thread.	Torque required.	
40° ..	11 foot pounds ..	$11 \times \cos 20° = 10·34$
50° ..	13 ,, ,, ..	$13 \times \cos 25° = 11·7$
60° ..	18 ,, ,, ..	$18 \times \cos 30° = 15·6$

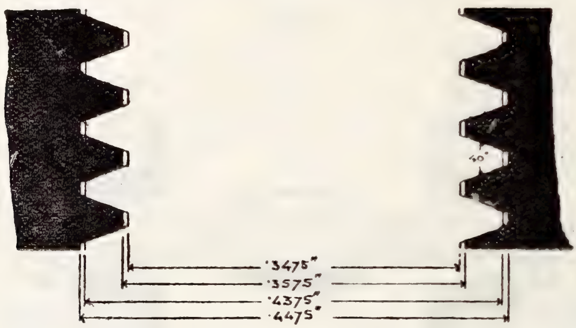
It will be observed that fractional resistance to un-

screwing increases with the angle of the thread much more rapidly than in proportion to the increased surface pressures due to the oblique thrust. The above figures, from specimens black from the hardening process, are higher than one obtained from a screw with a bright surface in a preliminary experiment, by about 90 per cent.

B.—Pull on the screw required to shear the thread out of a brass nut ·226 inch thick (3·6 threads) cut from flat drawn strip.

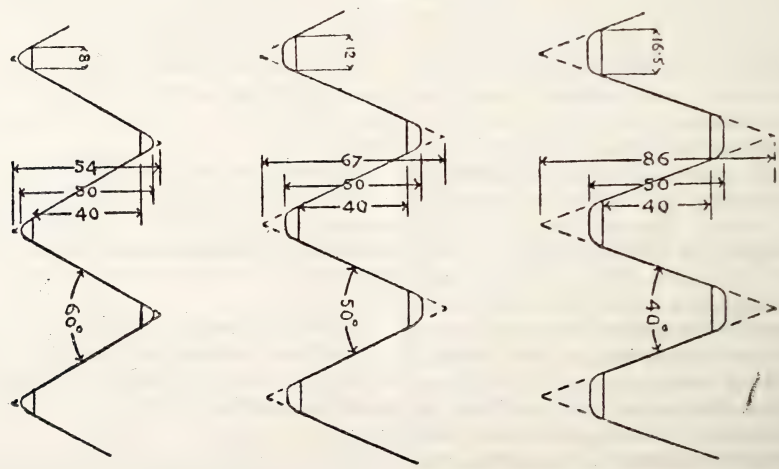
Angle of thread.	Force required to shear thread.	Area of thread sheared.	Shearing force per square inch.
	lbs.	sq. inch.	lbs.
40°	5,500	·2275	24,160
50°	6,200	·250	24,880
60°	6,590	·270	25,200

Fig. 5.



In this Table the area of the thread sheared is obtained from a measurement of the space left for the thread of the nut between the successive threads

Fig. 6.



of the screw, so that this area is less as the screw thread has a wider top.

C.—Pull required to shear the thread away from a cast brass nut ·250 inch thick (4 threads).

Angle of thread.	Force required to shear thread.	Area of thread sheared.	Shearing force per square inch.
	lbs.	sq. in.	lbs.
40°	(1) 4,890 (2) 4,760	·253	
	mean 4,825	..	19,080
50°	(1) 5,400 (2) 5,130	·2775	
	mean 5,265	..	18,960
60°	(1) 5,500 (2) 5,600	·300	
	mean 5,550	..	18,500

In these experiments only one screw and one nut were used in each pull, the connection to the other side of the hexagonal sleeve being made with a ½" steel bolt. Two nuts of each size were sheared. In this case no measurements were taken of twisting torque.

D.—The screw of 60° was tested on a brass nut ·250 inch thick (4 threads) made from hard drawn rod.

1. Screw broke at 10,280 lbs. along line *d*, Fig. 3.
2. Another similar screw sheared the nut at

10,820 lbs. Area sheared ·300 square inch. Shearing force per square inch 36,070 lbs.

In all cases the nut was sheared along the outside surface of the screw, not at the bottom of its own thread, so that the hole left was a tight fit for the screw which had been pulled through.

These figures suggest the following conclusions :—

1. That the angle of a flat-ended thread has little effect on the resistance of the nut to shearing, except so far as it affects the area of the surface to be sheared; and the advantage possessed by the 60° thread over the others is only due to the fact that its flat top is narrower than theirs, and the base of the nut thread correspondingly wider. From analogy with the relative behaviour of sharp and blunted dies used in stamping, it seems that a flat-topped thread with sharp edges should shear a nut more easily than a rounded thread.

2. That the strength of the thread of the nut, compared with that of the core of the screw, is such that generally in practice nuts are stronger than their screws.

For example a flat-ended thread of the dimensions of No. 0 B.A. of 40-ton steel will break before it strips the thread from a hard drawn brass nut $\frac{1}{8}$ inch thick. So a similar screw of the dimensions of No. 6 B.A. of the same steel will break sooner than strip a brass nut $\frac{1}{12}$ inch thick.

With steel nuts, the nut will generally be very much stronger than the screw.

3. Considering (*a*) that the holding strength of a screw bolt is generally determined (and that especially in small screws) by the resistance of the bolt under tensile stress; and (*b*) that, as ascertained by Professor Martens, the resistance of a screw bolt to fracture is very largely diminished by simultaneous torsional stress; it is desirable that such resistance as may be desired to tightening or loosening a bolt should be obtained by means of the friction of the under surface of the nut or screw head, and that the friction of the threaded surface of the screw itself should be as small as possible. From this point of view, experiments A indicate that an angle of thread of 40° or 50° is to be preferred to an angle of 60°, and that especially so in the case of small screws.

The authors of this report are under a great obligation to Professor T. Hudson Beare for his kind assistance in ascertaining the breaking strains of the specimens.

CUSTOMS REPORT.

The forty-fourth Report of the Commissioners of Her Majesty's Customs for the year ended 31st of March, 1900, lately been published, contains the following particulars :—

The gross Imperial Customs revenue collected in the year 1899-1900 amounted to £23,384,229, or, after deduction of drawbacks and repayments, to £23,043,472. This is £1,485,245 more than the produce of 1898-1899, and £1,273,472 more than the Budget estimate for the year. The Customs revenue has thus brought in 5·85 per cent. more than it was expected to produce, and 6·89 per cent. more than it produced in 1898-99.

The actual yield of revenue from coffee was £191,509, being an increase of £17,919, or 10·3 per cent. Chicory yielded £54,970, against £52,108 in 1898-99, an increase of 5·5 per cent. These increases are chiefly referable to the merely temporary effect of the war in South Africa. The additional clearances of coffee are due to the withdrawal of that article from bond to be roasted and prepared for campaign purposes, but when subsequently exported the duty is returned. Thus, £14,755 was paid as drawback upon coffee exported in the past year, against £3,593 so paid in the previous year. It is anticipated, therefore, that part of the sum brought to account as revenue from coffee in 1899-1900 will have to be returned as drawback in 1900-1901. The increased quantity of coffee taken out of bond was 27,300 cwts., and of chicory 4,300 cwts.

The receipt from cocoa in 1899-1900 amounted to £198,997, against £193,845 in the preceding year, an increase of £5,152, or 2·6 per cent. The year has been a very fair one for this branch of the revenue, though there have been considerable fluctuations. The most healthy sign is, however, that the whole of the increase has been in duty paid on raw cocoa, there having been an actual decrease in the yield from the foreign manufactured article. This shows that the efforts made by the manufacturers of the United Kingdom to prevent this industry from falling into foreign hands—a tendency to which we drew attention in our last two reports—have met with success. The quantity of cocoa upon which duty was paid in 1899-1900 was 42,663,000 lbs., as compared with 40,898,000 lbs. in 1898-99.

Currants produced the sum of £124,410 in the year under review, as against £120,695 in the preceding twelve months. There is very little to remark about this head of receipt (which is of a somewhat stationary character), except that in March last there was some apprehension in the minds of the trade that the duties might be raised, an impression which lead to rather large clearances at the time, and which is answerable for the increase of receipt.

The small branch of revenue from figs, plums, &c., yielded the substantial increase of £15,445, the total amount being £79,766, as against £64,321 in 1898-99. The increase is 24 per cent., and is chiefly caused by the increased imports of figs from Asia Minor, which were 29,325 cwts. in 1898, and 103,804 cwts. in 1899.

The revenue from raisins was £220,034, compared with £196,989 received in the preceding year—a year of exceptional depression in this trade, owing to limited supplies. The increase of £23,045 in 1899-1900, therefore, only marks a return to normal conditions.

The amount of duty paid on tea in 1899-1900 was £4,628,946, which, compared with the amount paid in the preceding year, shows an increase of £605,442.

But this does not fully represent the conditions of the tea revenue in the past twelve months. We have already explained that as much as £100,000 of the heavy payments made in the closing days of March, 1899 – representing about 6,000,000 lbs. of tea—did not reach the Exchequer until after the ensuing 1st of April, and consequently fell into the revenue account of the year 1899-1900. In 1898-99 the amount of revenue paid into the Exchequer from the tea duty represented 236,000,000 lbs. of tea. In 1899-1900, the quantity represented by the duty was 279,000,000 lbs.—an increace of 43,000,000 lbs., or 18 per cent. This enormous increase, representing £800,000 of revenue, was due in very different proportions to the three causes—(1) increase of consumption in consequence of the exceptional prosperity of the country; (2) panic owing to fear of a large rise of duty; and (3) the increased duties; and it is interesting to measure the influence of each of these causes in building up the increase. Approximately they are as follows: –

	lbs.	Revenue. £
(1) Increase of consumption	6,000,000 ..	100,000
(2) Forestalling	37,000,000 ..	620,000
(3) Increase of duty....	— ..	80,000
	43,000,000 ..	800,000

It will be observed that the increase of consumption—6,000,000 lbs. — was unusually large, being about double the rate to which we have been accustomed in recent years, and it is another corroboration of the very prosperous condition of the population.

In the case of tobacco, as in the case of tea, the disturbance of trade prior to the Budgets of 1899 and 1900 renders the table of the net receipt a very imperfect guide to the state of the revenue. The amount of duty collected upon tobacco and snuff in 1899-1900 was £10,885,922, against £10,993,727 in 1898-99, a decrease of £107,805. But here, again, there was a panic at the end of March, 1899, in anticipation of an increase of duty, and, in consequence, about £600,000, which was hurriedly paid in at the end of the financial year, 1898-99, did not reach the Exchequer until the commencement of 1899-1900.

*THE LOCUST PLAGUE AND ITS SUPPRESSION.**

Locusts have devastated the greater part of the habitable world, and during the last ten years have done great damage in the southern republics of South America, in North and South Africa, in India, &c.—countries widely separated from each other—and they have caused great loss of human and animal life in large areas in Africa belonging to Britain. The importance of the subject is therefore considerable. But the difficulties which hitherto have been connected with the plague seemed excessive and insuperable barriers in dealing with it effectually.

To illustrate the remarks in this paper I select the four following typical and well-known species of the insect, namely, 1, the *Caloptenus spretus*, or Rocky Mountain locust; 2, the *Stauronotus criatus*, or Cyprian locust; 3, the *Schistocerca paranensis;* and 4, the *Acridium peregrinum*, or Old World locust, in order to emphasise in a more pointed way certain aspects or characteristics of the insect that I think it well to put prominently forward in attempting to bring this plague under review, and ask favourable attention as to the best means to check it and alleviate the distress.

(*a*). Our increased and gradually accumulating knowledge of the habits of the insects is derived mainly while the insects come to and sojourn in their temporary home, for we do not yet know them in their permanent or true homes. The one and only success in combating the plague by human means in the whole history of the world was due to the putting in force the simple observation that the yonng (or the old) locusts cannot adhere to smooth surfaces, such as glass, owing to the fact which is now made abundantly clear, namely, that, unlike flies, the processes or claws on the feet of their front and middle pair of legs are too short and weak to enable them to do this.

(*b*.) The general and characteristic features of the locust run through all the species alike. This fact has been greatly lost sight of or minimised, and the differentiations which help to mark off one species from another have been magnified into an unjustifiable and unnecessary importance. The instincts and the structure of all the varieties are very nearly alike, although one species may not be so large or have different markings as compared with another.

(*c*.) The *direction* which the "army" assumes when the larvæ at a certain period set out for and continue on their "march" is a most important matter to settle and be certain about, as this is the most destructive period in the life of the insect. They then devour everything that comes in their way. Not so with the flight of flying locusts, which only levy toll here and there as they pass or sojourn. The "army on the march" usually pursue a straight given course, irrespective of all obstacles and dangers (natural or artificial) that may be in their way, minus any with smooth surfaces owing to the reason above stated. Now the course or direction of the "march" will be found (though further observation is requisite to confirm the truth fully) to be always in a given direction in certain countries. Thus in the Argentine and South Africa they travel southwards, in Algeria northwards, in the United States eastwards, and so on. It may not be true south, or true north, or true east in the respective instances mentioned, but it will be respectively towards the south, north, or east, as the case may be. The important thing to bear in

* Abstract of a paper read before Section D of the British Association at Bradford by Æ. Munro, M.D.

mind is that they all march in one general direction as a body at the same time, and without any leader; while so far as suitability and abundance of food are concerned to satisfy all their instincts an exactly opposite or other direction would be far better. The "Screen and Trap" or "Cypriote" system was based on the supposition that the insects march in a given specific direction. It has been owing to this fact that the power of the plague was broken in the course of *one year* (1883) in Cyprus, although it baffled all efforts to check it for centuries before. Since the suppression of the plague, and no doubt very much on account of it, Cyprus has entered on a new era of prosperity.

Outline of the Means for Checking or Suppressing the Plague.

There is a sense in which a plague or pest such as that of locusts may be regarded as the increase over the natural checks with regard to the normal number. When this gain takes place it is now almost universally admitted that human measures ought to be resorted to with the view of aiding the natural agencies, so that the insects may be reduced in number to a point that is safe or free from danger.

1. *The Natural Agencies for Checking the Plague.*—Destruction by (1) the wind; (2) birds; (3) reptiles, lizards, toads; (4) mammals and fish; (5) wasps; (6) disease—(*a*) internal larvæ from the Tachino fly, (*b*) Mylabris parasite, (*c*) Mermis parasite, (*d*) Cynomia pictifaceis parasite, (*e*) Empusa grylli parasite, (*f*) various others, such as mites; (7) eggs destroyed by insects, animals, weather, water.

2. *Artificial and Mechanical Means for Checking the Plague.*—1. Ingenuity or finessing; 2. Destruction of the eggs by—(*a*) Machines, ploughs, harrows, (*b*) eating by pigs, (*c*) tramping the ground, (*d*) irrigation, (*e*) judicious use of chemicals, (*f*) collecting the eggs; (3) destruction of hoppers by—(*a*) maiming, (*b*) crushing, (*c*) tramping with stock, (*d*) diverting, (*e*) catching and bagging, (*f*) trapping, (*g*) burning, (*h*) use of chemicals, (*i*) inoculation of fungi; (4) destruction of the winged locusts by—(*a*) diverting a flock or flight, (*b*) shooting them on the wing, (*c*) maiming, (*d*) chemicals, (*e*) tramping, (*f*) crushing, (*g*) burning, (*h*) catching and bagging, (*i*) inoculation of the flying locust with a fungus.

NEW METHOD OF PRODUCING HIGH TEMPERATURES.

The Times last week gave a very full report of a paper on this subject by Mr. E. D. Lange, of Manchester, read at the Paris meeting of the Iron and Steel Institute. The author had seen the system described, the invention of Dr. Hans Goldschmidt, in operation at the courts of the Chemische Thermo-Industrie Company at Essen, and had concluded that for various metallurgical purposes the engineer and chemist had now at their disposal a new and powerful agent sufficiently cheap and effective and sufficiently under control to justify its existence both from a practical and commercial point of view. The principle underlying the process is not new, being based upon the heat energy developed by the chemical action of aluminium upon oxygen, or rather that between aluminium and certain metallic oxides. It is rather the manner in which this action is developed and its product applied which constitutes the novelty of the process.

The author referred to previous experiments made by Wohler, Sainte-Claire Deville, Claude Vautin, Bunsen, Tissier, Michel Beketoff, Rose, Percy Greene, Wahl, of Philadelphia, and others. Some very interesting laboratory experiments showing the possibility of producing pure iron by reducing ferrous oxide with aluminium were brought before the institute in 1895 by Robert Abbott Hadfield, whose services to the metallurgy of iron and steel have been of the most valuable kind, and in the same year Sir William Roberts-Austen gave a brilliant demonstration before the Royal Institution upon the "reduction of the rarer metals from their oxides," on which occasion several of the rarer metals were produced in some quantity, by reduction with aluminium, in a manner which appeared almost magical. Among other valuable investigations since then have been those of Moissan, Kupelwieser, Matignon, Helouis, Duboin, Gauthier, and Francke.

Dr. Goldschmidt made experiments with the object of discovering a mode of controlling the violent reaction obtained by the heating of aluminium in contact with metallic oxides, and these brought to light the important fact that it was not necessary to heat the whole mass up to the requisite temperature for ignition, but that it sufficed to start ignition at any one time. When combustion once started the reaction proceeded steadily with more or less speed throughout the whole mass, thus generating within itself the whole of the heat required. In the case of the refractory oxides, it would have been a difficult matter to apply the requisite heat for ignition at any point had not Dr. Goldschmidt made the still more important discovery that although certain oxides combined with aluminium at so low a temperature that they could be ignited with an ordinary match, yet they nevertheless, in their combustion, developed so much heat that if a small quantity of these oxides was placed upon a mixture of refractory oxide and aluminium and ignited a reaction was started in the same, which, thus originated, then proceeded automatically as before. The heat developed by the combustion of a mixture of alumina and iron is sufficient to start the reaction between the aluminium and iron oxide mixture, and as this proceeds more and more of the same is added until within a minute or two there is a crucible containing reduced iron covered by a thick coating of alumina slag. On pouring off the slag the temperature of the underlying liquid iron can be tried by pouring it on to a mild steel plate or along the side of a mild steel

bar, when the hot iron cuts its way through with ease. Pyrometer experiments have established the temperature reached in the operation at between 2,900° C. and 3,000° C., that is to say, 1,000° C. more than that reached during the hottest period of the Bessemer blow. In the case of the reduction of chrome from its oxide by this method, the temperature of 3,000° C. is certainly reached—a temperature hitherto obtainable by the electric arc alone. Aluminium is, therefore, a very powerful source of heat, wonderfully condensed and portable and adaptable to many industrial operations. Aluminium and oxygen are two of the most common of the elements of which the earth's crust is composed, and it can hardly be doubted that the price of aluminium, already low, will be still further reduced in the future. The production of carbonless chrome and manganese on this system was next described.

It was explained that welding by means of aluminium mixture is conducted by pressing together the two ends of the bars or pieces to be welded, and then placing round the part to be welded, but separated from it by a fixed distance, a form made of thin iron sheeting supported by being packed round with moulding sand. The combustion of aluminium and iron oxide is then effected in a crucible of fitting size and the contents of the crucible poured into the form. As soon as the part to be welded has taken up sufficient heat the weld is accomplished by pressing the two parts together by means of a suitable clamping arrangement. Raw aluminium of 50 per cent. purity made from bauxite has a sufficient effect. It is of no consequence how far the reduced iron is pure or impure. On the other hand, if it is proposed to use the reduced iron to form part of an iron or steel structure its purity or composition might prove an important matter. With regard to the comparative cost of the joint as compared with a fishplate joint, Dr. Goldschmidt has prepared some figures in which consideration is given to the cost of the maintenance of the fishplate joint, and he makes out a favourable case for the welded joint. The reports on this subject have been hitherto of a favourable character.

It appears more than likely that this process will be largely used in the future in order to secure continuity of conductivity in the return current on electric railways. With regard to the comparative cost of welding by thermit and electricity and of welding by electricity, it is hard to find common ground for a comparison, as the number of cases in which electricity is sufficiently available and its use expedient is necessarily limited.

The author concluded by pointing out the unsuspected property of aluminium as a heat accumulator whereby it is rendered possible to release in the form of heat, everywhere and with the greatest ease, the work which was required for the original production of the aluminium. Another thought is not far removed from this—namely, the possibility of using aluminium not only for the processes described, but to discover a means of turning the heat of combustion of the aluminium back into electricity for the production of power. It is, indeed, possible that in the future the value of aluminium will lie not only in its properties as a metal, but also in its importance as a power accumulator of the highest efficiency.

General Notes.

Technical Instruction in London.—The Technical Education Board of the London County Council has decided to contribute towards the maintenance during the coming year of the Technical Departments of the London University, the sum originally mentioned as the board's possible contribution. For the ensuing session this grant will be allocated as follows:—The board is already contributing £5,000 a year towards the maintenance of some of the constituent colleges which have been recognised as schools of the new University; and, in addition to this sum, the board has decided to devote £2,500 a year to the faculty of engineering, and £2,500 a year to the faculty of economics and political science (including commerce and industry). The board has, moreover, expressed its intention of contributing towards the development of a system for the training of teachers in connection with the new University. Further, the board, as appears from its annual report just published, is of opinion that "considerable sums, both from public and private sources, will be required to enable the University to discharge its functions in an adequate manner." In this connection, the board quotes the view of the Statutory Commissioners, that "statutes and regulations will not make a living university," but that "large funds will be needed for the remuneration of of University professors and lecturers, and the provision and maintenance of libraries, museums, laboratories, and workshops."

Profits on German Farming.—For the purpose of furnishing information with reference to new commercial treaties, investigations concerning the profits of a large number of farms have been made by the authorities in the kingdom of Wurtemburg. Ninety-four were selected, including the smallest and those of several hundred acres. The appraised value amounted to £594,000; the average value per acre to £45, varying from £15 to £170. The average profit per acre was about 4s., or according to Consul-General Guenther, of Frankfort, 1·7 per cent. of the total appraised value. The several establishments, however, showed very different results. Of the 94 farms, 9 worked with a loss. Of the remainder, only 16 returned interest on the working capital, 19 yielded 5 per cent. on the working capital and 3 per cent. on the investment for buildings; fifty yielded 5 per cent. on the working capital and 3 per cent. on the capital invested in buildings, and in addition, an income on the lands (*grundrente*), which latter, in two instances, amounted to 5·2 per cent.

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TABLET TO RUSKIN.

John Ruskin was born in Hunter-street, Brunswick-square, on February 8th, 1819, and lived there until about 1823, when his father removed to a house on Herne-hill. He was, therefore, only four years old when he left the house, but he was a precocious child, and in his *Preterita* he specially refers to his old home. He writes, "As days went on he [his father] was able to take a house in Hunter-street, Brunswick-square, No. 54 (the windows of it, fortunately for me, commanded a view of a marvellous iron post, out of which the water carts were filled through beautiful little trap doors, by pipes like boa-constrictors; and I was never weary of contemplating that mystery, and the delicious dripping consequent); and as years went on, and I came to be four or five years old, he could command a postchaise and pair for two months in the summer." He took his early London home as an illustration of his views on the picturesqueness of England, when he expressed his well-known sentiment that, although he had many kind invitations to visit America, he could not, "even for a couple of months, live in a country so miserable as to possess no castles." He put his philosophy in this form: "I saw nearly all the noblemen's houses in England; in reverent and healthy delight of uncovetous admiration,—perceiving as soon as I could perceive any political truth at all, that it was probably much happier to live in a small house, and have Warwick Castle to be astonished at, than to live in Warwick Castle and have nothing to be astonished at; but that at all events, it would not make Brunswick Square in the least more pleasantly habitable to pull Warwick Castle down."

Ruskin's love went out to all the places associated with his early life, and he speaks with affection of the house at Herne-hill—"a rustic eminence, four miles south of the Standard in Cornhill, of which the leafy seclusion remains in all essential points of character unchanged to this day," and adds "I can still walk up and down the piece of road between the Fox Tavern and the Herne-hill station imagining myself four years old."

The house in Hunter-street, which stands on the west side of the street, a few doors from the square, was No. 54 when Ruskin's father occupied it, and it is still marked by the same number, although a few years ago it nearly escaped becoming a portion of Judd-street. In January, 1887, the Metropolitan Board of Works ordered that Hunter-street should be incorporated with Judd-street, and that the whole line of thoroughfare should be renumbered—the even numbers on the east side and the odd numbers on the west side. Opposition to this order was raised by the inhabitants of Hunter-street and by the Governors of the Foundling Hospital, with the result that the order was modified in the following August. The portion of Hunter-street situated in the parish of St. Pancras was joined to Judd-street, and the houses renumbered. The portion of Hunter-street situated in the parish of St. Giles and St. George, Bloomsbury, has, therefore, a gap in its numbering, Nos. 18 to 26 on the east side and 27 to 36 on the west side being incorporated with Judd-street.

The Council of the Society of Arts have within the last few days placed a tablet on the front of the house No. 54, with this inscription: "John Ruskin, Artist and Author, born here. Born 1819—Died 1900."

RUBBER IN RHODESIA.

A report on the rubber industry of the British South Africa Company's territories has been prepared for the company by Mr. Lyttleton Gell, and the following particulars extracted from it are taken from the *Board of Trade Journal*:—

It is now ascertained that extensive tracts in North-West and North-East Rhodesia produce natural rubber of high commercial value, while in Southern Rhodesia indigenous rubber is reported in abundance in the Sabi Valley and along the Zambesi. There is also good ground for believing that various foreign species of a yet more valuable character can be gradually established throughout the territory, and there are certain kinds which may be expected to thrive even in the dryer climate of the Southern Rhodesia plateau.

On the other hand, the native methods of extraction are very destructive, and in the absence of protective regulations the opening of markets will inevitably tend to the rapid extirpation of indigenous

rubber trees. Further, the existing methods of preparation are faulty, and impair the market value of South African rubber.

The indigenous rubber, which (so far as official information goes) has at present been identified in the British South African territories, belongs chiefly to the class of gigantic creepers scattered amongst other growths.

Passing on to the administrative aspects of the rubber industry, the elementary principle which emerges is this—that the indigenous rubber must be regarded from the first as State property (as in the Congo, Lorenço Marques, and Mozambique territory), and should not be abandoned to private exploitation. It represents an exhaustible accumulation of natural capital, to which neither the nomadic natives nor the casual adventurer has any proprietary claim, but which should be husbanded, and, if possible, increased to sustain the immense expenses of developing a new territory. The native, who extracts it, and the trader, who exports it, must, of course, receive an adequate inducement for their services. But in the indigenous stage the rubber industry does not require any outlay on plant or large capital. It is not speculative; the settlement of the country diminishes the traders' risks. Transport is comparatively cheap for an article highly valuable in proportion to its bulk. No expensive management is involved. Accordingly, whatever profit there may be after the native and trader have been reasonably remunerated should be retained.

The problems which present themselves may be conveniently dealt with in the following order:—

1. The measures necessary to preserve the existing sources of rubber.

2. The methods of obtaining a revenue from the industry.

3. The future development and expansion of the industry, including the suppression of detrimental methods of extraction and preparation.

4. The policy towards proposals of exploitation.

The systems established for the protection of the rubber industry in other territories have been of the following types:—(*a.*) Forests, including rubber trees, are reserved as State property; they are directly administered, and the rubber is collected by a forest department. (*b.*) The forests are retained as State property, but private enterprise is permitted over specified areas under terminable leases and strict conditions. (*c.*) Tracts of forest are transferred to private or joint stock ownership, and the development is left to individual action under some degree of legislative regulation. (*d.*) Forests are abandoned to the first comer, subject to more or less effective regulations as to methods of extracting or trading rubber; this appears to be the usual British principle outside India, and the least wise of any.

The regulations existing in other African territories afford some useful suggestions, though, speaking generally, they appear to be very imperfectly enforced.

Congo State.—(*a.*) No unauthorised extraction of rubber is permitted. (*b.*) The industry is largely worked by the State, but concessions for extracting rubber within fixed areas and for limited periods are also granted, the lessees being bound to conform to the regulations applicable to the State forest. (*c.*) In each year the Department of Forests or the lessee must plant a number of new trees, bearing a fixed proportion to the weight of rubber extracted; if lessees neglect to keep up plantations, the Government may intervene and charge the expenses to the lessee, or may cancel the license to collect rubber. (*d.*) The felling of rubber trees is forbidden under heavy penalties. (*e.*) Extraction of root-rubber is forbidden, and no method but that of incision may be used.

Penalties of from 100 francs to 10,000 francs and imprisonment of ten days to six months may be imposed, employers, directors of companies, and State agents being liable for the payment of fines incurred by their servants.*

Lorenço Marques.—A monopoly of the production and trade in rubber for twenty-five years has been granted over the unoccupied State lands. The concessionaires pay a rent of 200,000 reis (=£44 7s. 11d.) per annum, and undertake to plant 20,000 trees in two years. They further pay a duty of 50 reis (=2·65d.) per kilo. for seven years, rising to 75 reis (=4d.) per kilo. for the remaining eight years. They are exempt from all other imposts. They have the option of retaining the land at the same rent at the expiration of the monopoly. The monopoly does not restrain the cultivation of rubber on private property and its export by private persons.

The Mozambique Company forbids any individual to purchase rubber from natives, or to extract it through agents, without a special annual license, extending only from 1st February to 31st August, which cost £3 per annum. Thirty reis (=1s. 6d.) per kilo. must be paid before rubber can leave the district in which it is collected, and a receipt for the tax must always accompany the goods. Every person purchasing rubber or collecting it must keep books showing the amount received daily, and report it once a month to the District Official. All warehouses, and consignments of rubber in transit, whether by river or land must be open to inspection on demand.

Lagos.—The system in Lagos is based upon a theory that the ownership of forests is vested in the local tribes, under their "native authorities," *i.e.*, chiefs. Within districts under the control of such "native authorities" no person may collect rubber without a license, for which he pays £5 to the "native authorities," and 2s. for each load of

* Export duties on rubber are fixed at 10 per cent. by Treaty with France and Portugal. There is apparently an additional duty of 50 centimes per kilo. fixed in February, 1898, and a fee of £200 is charged for every license to establish an india-rubber warehouse. Natives who hold licenses to collect rubber, apparently have the option o compounding for their fees by paying one-fifth of the rubber collected to the State.

rubber. No tree of less girth than 3 feet at a distance of 3 feet from the ground may be tapped. It may not be tapped more than once in 18 months, and only in the manner prescribed by the "native authorities." The preservation of the protecting timber is also provided for. No tree of a girth less than 9 feet at a point 10 feet from the ground may be felled, and a similar tree must be planted in the nearest suitable spot within seven days. A permit must be obtained from the "native authorities" for all trees felled, and a fee of 5s. a tree must be paid.

The British Central Africa Protectorate has not yet established any adequate system for preserving the rubber industry and deriving substantial revenue from it. The British Central Africa Protectorate does, however, forbid the destructive traffic in root-rubber and rubber obtained by boiling bark, and it levies a 5 per cent. transit duty on rubber for the maintenance of roads, &c., which produces about 1½d. a lb. Regulations against frauds in rubber have been also promulgated.

There will probably be no hesitation in recommending that immediate regulations should be framed for North-West, North-East, and Southern Rhodesia for the protection of wild rubber which should embody certain well ascertained principles, *i e.*:—(*a.*) A minimum age and girth should be established, below which a tree must not be tapped; the exact measurements must be adapted to different species and localities, so that legislation should only establish the principle empowering our officials to promulgate the precise regulations for each district, after reports have been received as to the nature of the rubber plants there prevailing. (*b.*) The intervals at which trees may be tapped should also be regulated. Subject to local modifications, it would be safe to forbid tapping the same trees, or the same area, in two successive years. (*c.*) A general regulation will be required that rubber may only be collected by tapping, that no tree may be cut down, and no roots grubbed up and boiled; on the other hand, to avoid unreasonable rigidity, or to deal with exceptional conditions, a local official should be empowered to modify this regulation.* (*d.*) A general regulation is desirable providing for the plantation of young rubber trees in forest land by persons extracting rubber, in some proportion to be fixed by the local official, and a small reward for every tree planted should be paid.†

If in special districts the extraction of root rubber is permitted, the rate of replantation must be high—not less than two to one. (*e.*) The forest trees which provide the indispensable shade must also be protected from destruction. (*f.*) Powers should be taken to forbid absolutely the extraction or sale of rubber in a district for a fixed period; as a penalty for breach of regulations, or merely as a protective measure.

As regards the future development of the industry, the important points are as follows:—(*a.*) The steady replanting of indigenous trees, and the preservation of the shade trees in forest areas. (*b.*) Improved methods of extraction and preparation. (*c.*) The introduction of superior species in cultivated areas. (*d.*) The formation of a small forestry department, a member of which would have special experience of rubber.

* Root rubber is reported in North-West Rhodesia as a special product of the country. Unless it differs from other rubbers extracted from roots the process is not to be encouraged.

† In Indian forest districts the systematic plantation of any trees which it is desired to establish is secured by paying the natives trifling rewards for sowing seeds, distributed to them during the last season before they migrate from exhausted clearings to take up fresh ground. Small further payments are annually made for three or four years as a reward for weeding, &c., until the new trees can protect themselves. This system has proved effectual and cheap.

*ELECTRIC FURNACES.**

The author takes as archetypes of all modern electric furnaces those of Siemens and Huntingdon and Moissan. The first of these consisted of a crucible of some refractory earth, receiving current at its base, a movable carbon pencil fixed within it acting as the second electrode. The arc was thus formed between the lower point of this carbon electrode and the surface of the materials contained within the crucible. The Moissan furnace consisted of a block of lime, hollowed out at its centre to receive the materials to be heated, and provided with horizontal channels for reception of the two carbon pencils conveying the current. A second block of lime, fitting over the first, completed this furnace, and served to retain the heat emitted by the arc which formed between the points of the two carbon pencils, when the electric current was passed along them. The materials in this furnace were placed in the hollow cavity in the centre of the block, and the arc played *over* their surface.

The first of the electric furnaces developed from the above laboratory types for industrial purposes was that of the brothers Cowles. In this furnace the material to be treated was placed between two conducting surfaces, which conveyed the current, and was surrounded by non-conducting finely-divided material. The current was thus obliged to traverse the material lying between the two electrodes, and if this in the unfused state was a non-conductor of electricity, movable carbon electrodes were used in order to form an arc above the furnace contents, and bring them to the fused condition. This furnace, invented in 1885, and improved in 1887, was used at Milton in Staffordshire for reduction of aluminium oxide, and for production of aluminium alloys.

The Héroult furnace introduced at a later date for obtaining alloys of aluminium with copper, was based upon the same principle as that of the Cowles brothers. This furnace has been used at Froges and at Neuhausen for production of aluminium, and more

* Abstract of a paper read before the International Electricity Congress, at Paris, by M. Keller.

recently for the production of calcium carbide. The modified form adopted for the latter manufacture consists of a box mounted upon wheels, the base of which is of carbon, and the sides of some non-conducting material. The base of this box acts as one electrode, and a carbon rod, subject to a vertical up-and-down movement, forms the second. The furnace body is thus movable, and can be wheeled away when the reaction is completed, in order to be replaced by a newly-charged one.

The author next classifies the furnaces designed for calcium carbide manufucture as: (1) Arc furnaces (based on the Moissan and Siemens type); (2) Resistance furnaces (based on the Héroult type); (3) Incandescence furnaces (based on the Cowles type).

Arc furnaces may be again sub divided into three classes, according to the mobility of one or both electrodes and the number of carbons used. The furnaces designed by Patin, by the Deutsche Gold und Silberscheide Anstalt, and by Street, have both electrodes movable, and thus come under subdivision I.

A very large number of furnaces fall into the second group, having one electrode fixed—generally as hearth or floor of the furnace. The furnaces exhibited by the Société des Carbures Métalliques at the Exhibition, and those designed by Siemens and Halske, Schuckert, and other well-known firms for carbide production, are of this type.

To the third sub-division belong all forms of the multiple arc furnace, which has lately become much used, because it enables the area of arc heating to be greatly extended. The Gin and Leleux, Bertolus, Memmo, Nicolai, and Bovy furnaces are leading examples of this type. In most of these furnaces the floor of the furnace acts as the secondary electrode for the arcs which form between it and the three or more primary electrodes fixed around it. Polyphase currents are generally used with these furnaces.

In all arc furnaces the temperature attained varies with the intensity of the current used, but as in any case the temperature of the arc is very high, and considerably above that required, loss of energy follows from arc heating in carbide production. There is also considerable loss of material, owing to the finer material charged beiug carried away by the "blowing" of the furnace. For these and other reasons arc furnaces are not suitable for carbide production.

Resistance furnaces resemble in form and construction arc furnaces, but they work with a lower E.M.F., as the materials charged into the furnace body act as intermediate conductor between the two terminal carbons. The work done can be calculated by aid of the Joule formula $W = RI^2$, and the temperature attained is directly related to the sectional area of the electrodes. In this type of furnace the fusion of the materials is tranquil, and is unaccompanied by violent evolutions of gas. For carbide production an E.M.F. of 20 volts to 25 volts suffices, but heavier currents are requisite than with the arc furnaces, and conductors of larger sectional area must therefore be provided. The new furnace of the Compagnie Electrométallurgique des Procédés Gin and Leleux is of this type, and is employed in a large number of carbide works.

In the third class of furnace—incandescence furnaces—the intermediate conductor between the ends of the two electrodes is formed by a succession of small pieces of coke or other form of carbon. The passage of the current causes this bed of coke to attain a high temperature, and the materials placed upon it or mixed with it in their turn are raised to the same temperature. This type of furnace permits the utilisation within a limited area of the greatest amount of energy, and avoids the grave defect of the second type, namely, that the currents must always traverse the whole depth of the layer of materials already fused.

The author then passes on to consider electric furnaces under another classification, namely, that of the kind of current employed. Furnaces using continuous current have been sometimes called electrolytic furnaces, because in these not only thermal but chemical effects may be produced. Alternating current furnaces have latterly been widely adopted, because the dynamos yielding monophase or polyphase currents are better adapted to stand the resistance variations incidental to electric furnace operations.

The furnaces employing monophase currents are best arranged in series, for in this case it is possible to utilise a higher E.M.F. and to save copper in the necessary leads. If, however, arc-heating is being employed, it is better to connect the furnaces in parallel.

Bertolus, in 1897, was one of the first to patent the application of polyphase currents to furnace work. In the furnace designed by Bertolus triphase current was used, and three carbon electrodes were connected to the three terminals of the dynamo, while the hearth of the furnace itself provided the common return electrode. In later forms, the three different phases of the current have been utilised in separate furnaces, and these therefore each operate as though worked with monophase current.

Electrodes.—The difficulty of obtaining carbon electrodes of suitable size and length has for a long time hindered the increase of the size of the furnaces. Engineers have, however, given much attention to this question, which for the carbide industry is of considerable economic importance.

For those furnaces in which vertical electrodes are used, the carbon is generally formed square or rectangular in section, and undergoes special treatment in order to increase its conductivity, while for the other types of furnace carbons are usually made round.

In order to protect the carbon at the point where it entered the furnace, it was at one time customary to use water for cooling purposes, but this proved

dangerous, and it has been given up for cold air, or some form of protecting composition.

Regulating the Electric Current.—In the modern forms of furnace for carbide production, working with relatively low E.M.F., it is usual to find currents of 8,000 amperes to 10,000 amperes employed. With such currents it is impossible to use ordinary cut-outs, and it is customary to make the movable electrode of the furnace act as circuit breaker. On account of the accidents which may occur to the dynamo, steam engine, or turbine, when a single furnace is worked in this manner on an electric circuit, it is advisable to work several furnaces in parallel from the one dynamo.

Current Pressure.—The E.M.F. required in arc furnaces varies greatly, and depends upon the conductivity of the gases which are emitted from the heated substances. In the manufacture of carbide of calcium, an E.M.F. of 50 volts to 60 volts is required, in that of corrundum 50 volts suffices, while the electro-thermal method for production of iron only requires 20 volts.

In resistance furnaces a lower E.M.F. is generally sufficient, and carbide of calcium can be manufactured in the Héroult type of furnace with a current of only 25 volts pressure. Aluminium can be produced in the same furnace with a pressure of from 20 volts to 25 volts.

The third type of furnace, "incandescence furnace," can work with practically any E.M.F. up to 80 volts or 100 volts, for the resistance increases with the increase of the length of the bed of materials through which the curreut has to pass, and this may be varied at will.

Current.—In the Cowles type of furnace currents of 5,000 amperes at 50 volts to 60 volts have been used. In the Héroult furnace currents of 6,000 amperes are used. For carbide production it is more customary to use currents of from 1,000 amperes to 2,500 amperes with single pairs of electrodes, but where several pairs of electrodes are used for arc heating in the same furnace, this current may be doubled, trebled, or quadrupled. Furnaces with a single arc, and one movable electrode are, however, now being worked with currents of 5,000 amperes to 6,000 amperes. The Gin and Leleux type of resistance furnace can be worked with currents up to 10,000 amperes, and the same amount of current can be utilised in the incandescence furnace, which, working with a higher E.M.F. than the resistance furnace is able to utilise for thermal purposes no less than 1,000 kw. electrical energy.

Developments of the Electric Furnace Industry.—Recent estimates have placed the total energy employed in electric furnace operations at 230,000 horse-power, of which total, calcium carbide ac-accounts for 185,000 horse-power, aluminium for 27,000 horse-power, copper for 11,000 horse-power, and carborundum for 2,000 horse-power. In France alone it is estimated that 60,000 horse-power are employed in the carbide manufacture; while the production of phosphorus, vanadium, and ferro-chromium are more recent thermo-chemical industries started in Savoy.

The improvements made in electric furnaces in recent years have resulted in a greatly improved output of carbide per kilowatt hour, and in the latest form of the Gin and Leleux furnace it is now possible to obtain 6·20 kg. carbide per kilowatt day of 24 hours. This corresponds to a thermal efficiency of 75 per cent.

The paper closes with a few details concerning the electric furnaces which are exhibited in the electro-chemical section of the Paris Exhibition. Three of these are shown in operation, and comprise a Moissan furnace, a Bullier furnace, and a small model of the Gin and Leleux type of furnace. The first consumes 40 kw., and the second and third 70 kw. electiical energy when in operation.

The editor of *The Electrician*, from which this abstract is quoted, adds in criticism of the paper:—"M. Keller, being a Frenchman, naturally claims for Moissan an important place in connection with the development of the electric furnace, but we think he is incorrect in putting forward the Moissan laboratory furnace as a type from which forms now in use for industrial purposes have been derived. Moissan carried out his most valuable and classical laboratory researches upon high-temperature reactions in the years 1893 and 1894, and it is only just to point out that Siemens had devised and experimented with an electric-arc furnace 15 years earlier—namely, in 1878-79,—and that the Cowles furnace was used upon an industrial scale in America in 1885, and in this country one year later. These two furnaces, the Siemens and the Cowles, are, therefore, the original types upon which all later forms of arc and resistance furnaces have been based. M. Keller, in pressing Moissan's claims to be the inventor of a furnace which others have copied and turned to industrial uses, is therefore claiming for the latter a position which we are disposed to think the noted French chemist would hardly claim for himself."

ANTI-MALARIA CAMPAIGN.

The Roman correspondent of the *Lancet* has sent the following account of the systematic action of Italian physiologists in experimenting on the bites of mosquitoes as the cause of malaria.

The strenuous efforts now being put forth in Italy to combat malaria and tuberculosis make it necessary to return frequently to these topics in order to follow the progress of the campaign against them. In regard to malaria the *Accademia dei Lincei* publishes the first report of the experiments undertaken by Professor Grassi and others along the Battipaglia-Reggio line of railway from San Nicola Varco to Albanella, over a distance of some eight miles. The objects aimed at were two: (1) to prove that malaria can be contracted only through the bites of anopheles;

and (2) to find means of overcoming the practical difficulties that stand in the way of an efficient prophylaxis. Altogether 104 persons, including 38 children under 10 years of age, were kept under observation, all of them being railway employés with their respective families, living at the two stations and in various houses, 10 in number, along the line. The locality chosen, the Plain of Capaccio, is among the most unhealthy in all Italy. The persons selected for the experiment had all been examined during the non-malarial season — that is to say, before the anopheles had become infected—and those found to be malarious had been treated with quinine. The preventive measures adopted were the protection of the houses from the entrance of mosquitoes by wire gauze over the windows and the wearing by any persons obliged to be on duty outside after sunset or during the night of a simple veil attached round the hat with elastic, and of thick cotton gloves with tight sleeves. All who could went indoors at sunset and did not come out again till after sunrise. It was found very difficult, especially at first, to induce the people to observe these simple precautions in the efficacy of which they had no faith, but, nevertheless, of the 104 individuals experimented upon, excepting three cases of relapses which had escaped the previous treatment by quinine, not one has so far been attacked by malaria. This is very fortunate, for in spite of all precautions some anopheles succeeded in inflicting their bites, and although the proportion of infected insects is small (1 per cent.) one of these latter might easily have found its way into a house and inoculated some of the inmates. The better to supervise the experiment Professor Grassi spent three days a week on his field of operations, sleeping at the station of Albanella with open windows (covered, of course, with the wire gauze), and the same was done, though for shorter periods, by Dr. Martirano and Dr. Blessich who assisted him. While the subjects of the experiment thus enjoyed a complete immunity from malarial fever the other inhabitants of the same locality, who may be regarded as so many control subjects, not having been protected in any way against the anopheles, fared very differently, having, it is stated, been all attacked, even those living under otherwise superior conditions. Other similar experiments have been carried out by Di Mattei in the Val Savoja* and by Dr. Fermi and Dr. Tonsini on the Island of Asinara,† near Sardinia. The former place is exceedingly malarious, and the mosquitoes are numerous; nevertheless, by the aid of wire gauze over the windows of the house, and the use of oil of turpentine on the hands and faces of the five inmates who carried out the experiment, the mosquitoes were kept away, and no case of malaria occurred during a period of four months. Elsewhere in the locality malaria was raging. In Asinara the conditions are peculiarly favourable for testing the practicability of entirely ridding a given area of malaria by destroying the mosquitoes investing it. Dr. Fermi and Dr. Tonsini, by destroying the larvæ with petroleum, and the adult mosquitoes by means of pyrethrum, chrysanthemum, valerian, and zanzolina, succeeded in exterminating anopheles in the island, and greatly diminishing the number of culex pipiens. At the same time use was made of wire gauze over the windows of the houses to protect the inhabitants from being bitten, with the result that no fresh case of malaria occurred in the island, although in the previous year 40 persons had contracted the disease there. The experiment was carried out last year from June to November, and is being continued this season.

* Annali d'Igiene Sper., fasc. 2, 1900
† *Ibid*

The last number of *Nature* also contains a notice of the work of Dr. L. Sambon and Dr. G. C. Low, of the London School of Tropical Medicine, in a part of the Roman Campagna, near Ostia, where scarcely a person spends a night without contracting a malarial fever of a virulent type. No quinine or other drug was to be taken as a precautionary measure, but the investigators were to live in a mosquito-proof hut from an hour before sunset to an hour after sunrise, so as to avoid being bitten by mosquitoes, which only feed during the night. The experiment was planned to test the reality of the connection between malaria and mosquitoes, and the *British Medical Journal* reports that it has been most successful. On September 13, Prof. Grassi visited the residence of the investigators with several other men of science, and gave his testimony as to the value of the experiment in the following telegram to Dr. Manson:—"Assembled in British mosquito-proof hut, having verified perfect health experimenters amongst malarial stricken inhabitants, I salute Manson who first formulated mosquito malarial theory.—Grassi." So far as the experiment has gone, therefore, the result is entirely satisfactory, and affords the strongest support to the mosquito theory of malaria. Additional evidence is given by Dr. Elliott, a member of the Liverpool expedition sent to Nigeria some time ago to investigate the subject of malaria fever, who has recently returned to this country. He reports that the members of the expedition have been perfectly well, although they have spent four months in some of the most malarious spots. They lived practically amongst marshes and other places hitherto supposed to be the most deadly, and they attribute their immunity to the careful use of mosquito nets at night.

Another experiment arranged in connection with the malarial investigation in the Campagna is described in the *British Medical Journal*. Drs. Sambon and Low have shown that by avoiding mosquitoes they avoid malaria; but this is, after all, only negative evidence, and its full value can only be appreciated in connection with the actual production of malaria in a healthy person in this country by the bites of mosquitoes containing the germs of the disease. The evidence is now forthcoming. A

consignment of mosquitoes which had been fed on the blood of a sufferer from malaria in Rome, under the direction of Prof. Bastianelli, was received in London early in July. A son of Dr. Manson, who offered himself as a subject for experiment, allowed himself to be bitten by these insects, and, though he has never been in a malarious country since he was a child, he is now suffering from well-marked malarial infection of double tertian type, and microscopical examination shows the presence of numerous parasites in his blood. Full details of the experiments will be published in due course; meanwhile, they must be regarded as affording the most striking confirmation of malaria by mosquito bites that has yet been obtained.

The number of the *Lancet* for September 29th also contains a paper by Dr. Patrick Manson on "Experimental Proof of the Mosquito Malaria Theory."

MINES AND QUARRIES.

The second part of the general report of Dr. C. Le Neve Foster, F.R.S., on "Mines and Quarries" for 1899, contains statistics relating to persons employed and accidents at mines and quarries in the United Kingdom.

The total number of persons employed at mines and at the quarries under the Quarries Act in the United Kingdom and the Isle of Man during the year 1899 was 862,161, of whom 764,166 were employed in or about mines, and 97,995 in or about quarries.

Of the 764,166 persons employed at mines 603,627 worked below ground, and 160,539 above ground; of the latter, 5,161 were females. Compared with the preceding year there is an increase of 16,330 males working below ground, and an increase of 6,676 males and of 35 females working above ground, making a total increase of 23,041 persons. The greater part of the increase occurred at coal mines. The total figure is the largest yet recorded. The increase in the number of females employed occurred at coal mines only; at metalliferous mines there was a diminution in the number of female workers.

In 1899, 1,032 separate fatal accidents occurred in and about the mines and quarries of the United Kingdom, causing the loss of 1,089 lives. Compared with the previous year there is an increase of 42 in the number of fatal accidents, and an increase of 14 in the number of lives lost. Of the 1,032 separate fatal accidents, 915 causing the loss of 972 lives happened at mines, and 117 causing the loss of 117 lives happened at quarries.

The actual number of deaths from falls of ground is practically stationary, but as the number of persons employed underground increases every year, the death-rate per 1,000 employed is diminishing, and consequently there is an improvement. However, the progress is slow.

In dealing with accidents from falls of ground, Dr. Le Neve Foster pays particular attention to the methods of preventing the falls of roof which have been adopted abroad, more especially to that initiated at Courrières.

The "Compagnie des Mines de Houille de Courrières" is a company working collieries near the town of Lens in the Department of the Pas de Calais, and employing 6,998 persons, of whom 5,794 work below ground. It possesses 44 seams of coal, with a total thickness of 153 feet (46 m. 60). The average thicknesses of the seams of the three kinds of coal worked are respectively 2 ft. 8½ in. (82 cm.), 2 ft. 10¼ in. (87 cm.), and 3 ft. 7¼ in. (1 m. 10). The annual output is now about 2,000,000 tons. The undertaking is therefore sufficiently extensive to furnish average data of real importance.

The precautionary measures adopted at Courrières consist (1) in systematic timbering, and (2) in supplying each worker at the face with three iron bars 1⅜ inches square and 4 ft. 3 in. long, and compelling him to make use of these bars to form a temporary shield in advance of the last row of timber props. When another row of props are put in, the bars are withdrawn and then driven on in advance beyond the new set of supports. They are placed about 15 to 20 inches apart, and fixed securely by wedges. As the work proceeds, the temporary protecting shield must be pushed on; the men are now so practised that it takes them very few minutes to knock out the wedges, drive the bars forward, and wedge them up again. About 6,000 bars are in daily use at the Courrières collieries. If they get bent, which not infrequently happens, they can easily be straightened by the smith; on the other hand they rarely break, because if a great amount of bending indicates an unusual pressure of the roof, additional timber props are put in. Consequently the consumption of iron bars is trifling.

The remarkable fact set forth is the reduction in the death-rate from falls to the extraordinarily low figures of 0·15 per 1,000 persons employed, and 0·39 per million tons of mineral raised. These are not figures for one lucky year, but are averages for a period sufficiently long to warrant the assertion that they are not due to chance. Judged by either standard, the mortality in this country from falls of ground is five times as great.

The next point is to determine what share in the splendid improvement at Courrières belong to the two separate remedies.

Dr. Le Neve Foster writes:—"I learn from M. Lavaurs that systematic timbering with increased supervision was introduced in 1880, and that after trials in 1889 the use of the iron bars was made obligatory in 1890. It appears, therefore, that systematic timbering strictly enforced reduced the death-rate per 1,000 persons to one-third in the ten years 1880—1889, and that the employment of iron bars has now brought it down to one-fifth of what it was in the decades of 1870—1879. The Courrières authorities consider that

their present freedom from accidents by falls is largely due to this latter preventive measure.

"The brilliant results at Courrières afford ample proof of the value of two precautions recommended in the Home Office circular and warrant the prediction that the British death-rate will be very considerably lessened if these remedies are applied universally. If, further, the temporary iron supports are employed, there seems no reason why we should not in time bring down our death-rate as low as that of Courrières. This would mean a diminution in our death-roll by falls of ground from 450 to 90, or a saving of 360 lives annually, to say nothing of the prevention of many hundreds of non-fatal accidents.

"Objectors may rise up and say that Courrières is a safe mine, and that it is absurd to dream of reducing our heavy death-rate by falls to that of some favourable example in France. My answer would be that the Tables would be quite sufficient to refute this contention. They show that twenty years ago falls of ground were just as fatal per 1,000 persons at Courrières as they are with us now, and that reckoning by the million tons raised there was very little difference between us. These facts completely upset the supposition that Courrières can be called specially safe from natural causes."

*GROWTH OF SUGAR BEET IN ENGLAND.**

The sugar beet can be grown successfully in the south and east of England; the yield of sugar per acre is equal, if not superior, to other countries, where the industry is conducted on a large scale.

The economic question of the value of the industry is confused by bounties and duties; it is therefore necessary to ascertain the possible profit of the crop at the price of sugar which prevails in the open British market. It is also desirable to find the value of the crop for consumption on the farm, pending the general establishment of factories to deal with the roots grown in each district.

In 1898 a series of trials was carried out on farms in various parts of the country; the average yield per acre was 15½ tons of unwashed roots. This figure is probably too high, if roots with a high sugar content are grown; in the same year the average yield of six German estates, where an intensive system of cultivation is practised, was only 10·7 tons of washed roots per acre.

In 1898 six different kinds of sugar beet were grown upon the farm of the South-Eastern Agricultural College at Wye, Kent, the crop being managed in the same manner as the adjacent mangold break; the average yield per acre was 14 tons of unwashed roots, against 29 tons of mangolds. The sugar content was highly satisfactory, the season being one of prolonged warmth: it is calculated that about 1¾ tons of sugar per acre could have been extracted, representing a gross return of £18 10s.

In several respects the crop is more expensive to grow than mangolds; manure and cultivation were found to cost £10 8s. per acre, to which rent, supervision, and all incidental charges must be added.

The roots grown were stored with the mangolds until spring, and given, together with cake and corn, to two selected lots of sheep, with the general result that each sheep consumed 63 lbs. of sugar beet per week, against 146 lbs. of mangolds, and that the increase in live weight was 30·6 per cent. with beet and 37·2 per cent. with mangolds. Recalculating on a basis of acreage required, ten-elevenths of an acre of sugar beet will provide the same amount of succulent food for sheep as an acre of mangolds, and will supply 38 sheep for 12 weeks; the sheep on mangolds will, however, make 293 lbs. greater increase in live weight. The experiment showed that the beet forms an indifferent fodder for sheep.

Turning to the general question of the return to the farmer, the average price paid in 1898 in the six selected German cases mentioned above was 19s. 6d. per ton for roots delivered at the factory.

Assuming from the 1898 experiments an average production of 14 tons of dressed roots per acre, the gross return to the farmer at the above price would be £13 13s. The cost of cartage from the factory to the farm must be taken into account. It is estimated that the 3,000 acres of sugar beet which Lawes and Gilbert specify as required to maintain a factory would mean an average distance from farm to factory of four miles, the cartage over which distance would cost about 30s. per acre for the 14-ton crop. When this is added to the cost of cultivation and an allowance made for rent, &c., there is no margin left for the farmer from the gross return of £13 13s. per acre set out above.

The 19s. 6d. per ton for roots is a price that is not possible in this country, the price payable for the raw material being dependent on the price of sugar. Taking similar grades of sugar, the return received by the German manufacturer was in January, 1900, 13s. per cwt., while the price in England was 11s. 3d. per cwt., a difference of 35s. per ton of sugar. As 7½ tons of beet are required to produce a ton of sugar, this difference in the price of the finished product is equivalent to a reduction of 4s. 8d. per ton in the price payable for roots.

The English figures, then, become:—Average yield per acre, 14 tons; price at the factory, 14s. 10d. per ton; gross return to the farmer, £10 8s. per acre; against an expenditure that has been set at £11 18s. per acre, without including rent.

The success of the sugar beet industry depends upon several factors:—(1) Cheap technical skill in the factories; (2) a farming community working for smaller returns than prevail in Britain; (3) a system of bounties and countervailing duties.

* Abstract of a paper read before Section F of the British Association at Bradford, by A. D. Hall, M.A., Principal of the South-Eastern Agricultural College, Wye.

HORTICULTURE IN HUNGARY.

Little attention has been hitherto paid to the history of Horticulture in Hungary, but Dr. Charles Schilberszky, Professor at the Royal Hungarian School of Horticulture at Budapest, has produced a monograph on the subject in connection with the Hungarian Pavilion at the Paris Exhibition, which contains some important particulars. The following article by Mr. W. Roberts is taken from *The Gardeners' Chronicle* :—

The history of horticulture in Hungary may be conveniently divided into five periods : (1), Before the occupation of the country by the Hungarians ; (2), at the time of the Kings of Anjou to 1514 ; (4), from 1514 to the end of the eighteenth century; and (5), during the nineteenth century. In the first period the history is naturally misty, but Dr. Schilberszky has contrived to obtain a few facts; in the second, the records turn largely on the works of the monks, for a necessary pendant to a monastery was a garden. The Benedictines, the Cistercians, and the Premonstrants were all equally keen on the subject of gardens, and to them is due the credit of fostering and developing the cultivation of fruit, vegetables, and flowers. We get a few definite facts reelative even to gardening in Hungary in the thirteenth century, for Dr. Schilberszky quotes a statement, published by Fehér in the fourth volume of *Codex Diplomaticus*, in which it appears that the King, Bela IV., in 1256 made a present to eight inspectors of his gardens of the "*propriété foncière*" of Zud in the Department of Hont. At this period, and probably for long after, the fruit-garden was the chief feature in what was doubtless regarded as a phase of agriculture, and at the head of the fruits came "the national tree" of the Hungarians, the "Noyer" walnut. Other fruit-trees mentioned in the earlier records include the apple, the pear, the cherry, the prune, the sorb, the chestnut, the dogberry, the mulberry, and others, so that in the matter of fruit the mediæval inhabitants of Hungary were not badly off.

During the third division of time, and under the reigns of Charles, Robert, Louis the Great, and Sigismund, and especially under Matthias Corvinus, the pleasure garden developed very considerably, for the nation itself had attained to a certain standard of civilisation. The pleasure gardens were almost exclusively in the Italian style ; and one of the most important was that of the royal fortress of Visegrád, the barren rocks of which were converted into pleasure gardens by the king, Robert Charles. It is, it seems, this garden which produced the material of the celebrated perfumes of the Queen Elizabeth, which is know even now as the *Aqua Reginæ Hungariæ*. These gardens were visited by the King of Poland, Jagiel Ulászlo, when the guest of Sigismund, in 1412, as may be seen from a passage in the *Historia Poloniæ*, by János. They were greatly embellished by Matthias Corvinus, who also constructed the gardens of the Royal Château at Buda. Indeed, as became an enlightened king and scholar, this eminent mau indulged in a passion for parks and gardens in various parts of his kingdom, notably at Diósgyór and at Tata. His example was widely followed by eminent prelates and by noblemen. Fruit culture made great strides during this period, and a large number of varieties of different kinds of fruits were imported. One writer—Jean Czukor—states that, at this early period, there were cultivated in Hungarian gardens 76 varieties of apples, 61 of pears, 21 of plums, and 12 of cherries.

The three centuries comprised within the fourth division of time, *i.e.*, from 1514 to the end of the 18th century, included the period of devastation caused by the invasion of the Turks, who however introduced many important varieties of fruit into the conquered country, notably, apricots from Asia Minor, and several sorts of late grapes. The beautiful *Nymphæa lotus* is also believed to be one of their introductions, and many other plants regarded as indigenous to or raised in Hungary are now considered by the best authorities as Turkish introductions ; so that, if the yoke of the oppressor was hard, it had, at all events, some corresponding advantages. At the latter part of the 17th, and the earlier part of the 18th century, horticulture, but more particularly fruit culture, was largely in the hands of the clergy; indeed, the first gardening book in the language was written by a Jesuit priest, Jean Lippai. Fruit culture made rapid strides under the Queen Marie-Thérèse, and under her son, Joseph II. ; the latter, by a royal edict, in 1782, encouraged the planting of fruit trees by the roadsides. It was in his time also that the Botanic Garden of Szarvas was founded, and in 1785 the first "Société de Pomologie" was founded at Jolsva, in the Comitat of Gömör. In spite of the impetus given to gardening activity by the Esterhazy and Kraszalkovics families, the duration of this activity was comparatively short, and towards the close of the last century very few new gardens were constructed.

At the commencement of the present century the landlords of mountainous parts of the country, as in the Carpathians, and in Transylvania, had extensive orchards, and exported, principally to Poland, large quantities of excellent fruit; in due time orchards began to be formed also in the centre of the country. This movement was encouraged and imitated by the leading Hungarian nobles, such as Brunswick, Forray, Batthyány, Károlyi, and Pálffy. But it is only during the last thirty years of the present century that horticulture in Hungary has made rapid and universal strides. Enormous sums have been spent, and great sacrifices made by many of the chief landed proprietors, with the result that to-day one meets in nearly every part of Hungary with public and private gardens and parks, which will compare favourably with those of other European countries.

Among the great landed proprietors of the kingdom whose gardens are remarkable, the Archduke Joseph may be cited first, who, at an immense

sacrifice, and the outlay of several million of florins, has converted the Isle Marguerite (Magarethen-Insel), which has been so happily termed "the Pearl of Budapesth," into a very beautiful park and garden with an area of 140 arpents (an arpent is rather less than an English acre). This island was the park of the kings of the house of Arpád when it was known as Hare Island; it was subsequently inhabited by various religious orders, and numerous ruins of their buildings may still be seen. In 1790 the Archduke Alexander bought the island, and five years later it became the property of the Palatine Joseph; in 1847 it belonged to the Archduke Etienne, at whose death in 1867, it was inherited by the present owner. The five full-page plates published by Dr. Schilberszky, give a very fair idea of the romantic beauty of this place. The Archduke's English park at Alcsuth, comprises about 150 arpents, and includes a collection of orchids said to be the richest in the kingdom; whilst at a villa at Fiume, near the sea-coast, the winter residence of the family, he has an extensive collection of Conifers which covers about 8 arpents. The area of his parks and gardens is placed at 348 arpents. But two other great landed proprietors can claim more extensive parks and gardens than even the Archduke, for at Fóth, the Count Alexandre Károlyi has 398 arpents, and at Marton Vásár, Antoine Dreher has 380 arpents. The other owners of extensive gardens are the Count Theodore Andrássy, with 150 argents at Töke-Terebes; the Count Franz Esterházy at Tata, with 135 arpents; at Csálsvar, the Count Nicolas Maurice Esterházy has 117 arpents; and at Kapuvár, Prince Nicholas Esterházy has 43 arpents.

The botanic garden of the University of Budapesth has naturally played an important part in the progress of Hungarian horticulture. It was founded in 1849, and extends to about 26 arpents. It was arranged under the superintendence of Endlicher and Unger, and the number of plants now grown there amounts to about 6,000; the arboretum is laid out in the English style, and is very rich in varieties. The land devoted to gardening in the Hungarian capital is placed at 1,707,613 square mètres in the ten arrondissements; these are under the supervision of one head gardener, and six assistants, under whose superintendence the necessary work is carried out by labourers. The cost of maintenance is placed at 198,831 florins.

In 1897, the Hungarian Minister of Agriculture, M. I. Darányi, created a special department for the direction of affairs relative to horticulture generally, and to fruit culture in particular. This department includes two inspectors, and two travelling instructors. The establishment of State nurseries was another exceedingly wise and helpful movement, the object being to decide which were the most suitable fruits for particular districts; the varieties selected were cultivated in these State nurseries, and propagated in large numbers. There are twenty-two establishments of this description in various parts of the country, occupying an area of 219 hectares. One of the largest of these nurseries is at Torda, where the annual output of grafted trees is placed at 400,000. The prices are fixed by the Minister himself, and range from about sixpence to eightpence each for half-standards or standards, as the case may be. Last year nearly a quarter of a million grafted fruit trees were gratuitously distributed, chiefly to the peasantry. The movement has only been in operation for about eight years, and its full effects will not, perhaps, be very striking for some years to come.

The strides which horticulture has made in Hungary during the past 38 years is reflected in the annual budget. In 1862 its charge on the budget was 28,000 francs; last year it was 527,000 francs.

CINCHONA PLANTATION IN BENGAL.

The thirty-seventh Annual Report of the Government Cinchona Plantation in Sikkim for the financial year 1898-99, by Major D. Prain, M.B., Superintendent of the Royal Botanic Garden, Calcutta, and of Cinchona Cultivation in Bengal, and Government Quinologist, has been received, from which the following particulars are obtained.

From the Mungpoo division 267,505 trees and from the Sittong division 201,935 trees were removed; while 170,136 young trees were planted out. The net diminution in the number of trees during the year was thus 299,304. The extensions have taken place within the Mungpoo division and have amounted to 130·5 acres, of which 128·3 acres have been put under *Calisaya Ledgeriana* and 2·2 acres under hybrid cinchona. The area planted considerably exceeds that which it was hoped, in the last annual report, could be dealt with. During the coming season an effort will be made to plant 120 acres of *Calisaya Ledgeriana* cinchona. The disastrous effects of the abnormally low temperatures of January, 1899, on the stock of seedling plants alone prevents this estimate from being put at a higher figure. The nursery stock of seedlings on 31st March, 1899, stood at 138,080, a decrease, as compared with the corresponding date in 1898, of 74,707. The total number of plants estimated as remaining on the plantation on 31st March, 1899, is 2,179,245. The Superintendent, accompanied by the Deputy Superintendent, visited during the year the piece of forest known as the Narchu (or Enggog) block, which is at present held as a cinchona reserve. The belief that this block, owing to a too heavy annual rainfall, is unsatisfactory as a situation for a cinchona plantation was found to be justified, and Government has in consequence issued instructions to examine other forest land in the Darjeeling district in order to ascertain whether, in any block which is not at present held as a cinchona reserve, suitable land for the extension of cinchona exists. It has been ascer-

tained that such a piece of forest does exist, and it has been suggested that the necessary steps be taken to have this piece of forest converted into a cinchona reserve. The urgency of this question of extension is now greater than ever, owing to the conditions that have developed in the cinchona bark market since the presentation of the last annual report.

The Year's Crop.—The whole of the bark harvested on the plantation during the year has been taken from sickly or stunted trees, in pursuance of the policy detailed in the report of last year. The total quantity of dry bark harvested on the plantation has been 236,091 lbs., all but 35 lbs. of this being bark from one or other of the quinine yielding kinds of cinchona. During the year 131,615 lbs. of bark were purchased, partly from private plantations in Sikkim, partly from private plantations in Southern India. The undefined nature of the relationship of the Bengal and Madras factories respectively towards the bark market in Southern India rendered it advisable to expend only one-half of the grant of Rs. 50,000 provided for the purchase of bark and the carriage to the factory of the purchased bark; the total sum expended under these headings accordingly amounted to Rs. 24,243-6-10. The Superintendent was, in connection with this subject, directed in January, 1899, to meet in conference the Superintendent of Cinchona Cultivation, Madras. The result of this deputation has been a definite understanding regarding future purchases of bark in Southern India. With the exception of 80 lbs. issued to medical depôts and 923¼ lbs. sold to Government officers and to the public, the whole of the bark obtained during the year was taken into store at Mungpoo to be used at the factory.

Sales of the Manufactured Articles.—The issues of quinine during the year amounted to 8,766½ lbs., as against 10,939 lbs. in 1897-98; this is almost the same as the issues of 1896-97, which were 8,482 lbs. The decrease of 2,172½ lbs. may indicate either that malarial fevers were less prevalent during 1898-99 than during 1897-98, or that those who purchase quinine for distribution among the poor had fewer funds at their disposal during 1898-99 than during the preceding year. Of this decrease 890½ lbs. was due to a diminished demand on the part of the medical depôts in the Bengal and Punjab commands, 757½ lbs. was due to the transfer to the Madras factory of the obligation to supply the North-West Provinces with sulphate of quinine, while the balance of 528 lbs. represents a falling-off in the demand made by Government officers and medical missions for sulphate of quinine for distribution to the poor. The issues of cinchona febrifuge during the year amounted to 2,993¾ lbs., as against 3,398¼ lbs. during 1897-98. This decrease of 404½ lbs. is accounted for by a diminished demand on the part of Government officers; the medical depôts at Calcutta and at Mian Mir and the Inspector-General of Civil Hospitals, Bengal, indented for 100 lbs., 500 lbs. and 40 lbs. less, respectively, than they required during the preceding year. On the other hand, the demand for cinchona febrifuge on the part of the general public increased to the extent of 231¼ lbs. Cinchona febrifuge is the only article prepared at the Government factory that the general public may purchase direct, sulphate of quinine being available only in the form of pice-packets purchased at post-offices. There has been no falling off in the demand for quinine for pice-packets during 1898-99, as compared with 1897-98; the public demand for cinchona febrifuge has increased during the same period; in all probability, therefore, the need for these medicines was in no way less during 1898-99 than it was during 1897-98, and the true explanation of the diminished demand on the part of Government officers during 1898-99 is probably, therefore, the want of funds necessary to provide these drugs for the poor.

MEMORIAL TABLETS.

The following is a complete list of the Memorial Tablets which have been erected by the Society of Arts on houses in London associated with distinguished men and women:—

Joanna Baillie, Bolton-house, Windmill-hill, Hampstead.

James Barry, 36, Castle-street, Oxford-street.

Elizabeth Barrett Browning, 15, Wimpole-street.

Robert Browning, 19, Warwick-crescent, Paddington.

Edmund Burke, 37, Gerrard-street, Soho.

Lord Byron, 16, Holles-street.

[The house was pulled down in 1889. In May, 1900, Messrs. John Lewis and Son, silk mercers, erected on the front of the new house (now in their occupation) a fresh memorial, consisting of a bronze relief bust of Byron placed in an architectural frame of Portland stone.]

George Canning, 37 Conduit-street.

George Cruikshank, 263, Hampstead-road.

Madame D'Arblay (Fanny Burney), 11, Bolton-street, Piccadilly.

Charles Dickens, Furnival's-inn.

[The whole of Furnival's-inn was pulled down in 1898.]

John Dryden, 43, Gerrard-street.

Michael Faraday, 2, Blandford-street, Portman-square.

John Flaxman, 7, Buckingham-street, Fitzroy-square.

Benjamin Franklin, 7, Craven-street, Strand.

Thomas Gainsborough, Schomberg-house (now part of the War-office), Pall-mall.

David Garrick, 5, Adelphi-terrace.

Edward Gibbon, 7, Bentinck-street.

George Frederick Handel, 25, Brook-street.

Sir Rowland Hill, Bertram-house, Hampstead.

William Hogarth, 30, Leicester-square.

John Keats, Lawnbank, Hampstead.

Samuel Johnson, 17, Gough-square, Fleet-street.

Napoleon III., 3A, King-street, St. James's.

Lord Nelson, 147, New Bond-street.
Sir Isaac Newton, 35, St. Martin's-street.
Peter the Great, 15, Buckingham-street, Strand.
Sir Joshua Reynolds, 47 Leicester square.
John Ruskin, 54, Hunter-street, Brunswick square.
Richard Brinsley Sheridan, 14, Savile-row.
Mrs. Siddons, 17, Upper Baker-street.
Wm. Makepeace Thackeray, Kensington Palace-green.
John Thurloe, 24, Old-square, Lincoln's-inn.
Sir Harry Vane, Belmont, Rosslyn-hill, Hampstead.
Sir Robert Walpole, 5, Arlington-street.

The Council of the Society will be glad to receive suggestions from members of the Society or others who know of houses once the residences of celebrated persons, the owners of which would permit the erection of tablets.

GERMAN CAPITAL IN CENTRAL AMERICA.

The following figures show the efforts that Germany is making to build up trade in foreign countries, especially in Guatemala, Nicaragua, and Costa Rica. Her power in these countries is increasing from day to day. Her superfluous population which seeks to emigrate is guided and helped to settle in Central America. To these three countries a hundred German commercial houses and stores, large and small, with a capital amounting to £1,665,000, are, according to the United States Consul at Chemnitz, carrying on a thriving business. Half of these are engaged in importing and exporting. Not only the greater part of the German Central American trade (mostly in coffee and wood, amounting to about £1,428,000 annually) is carried on through these houses, but also a part of the English and Californian trade. There are besides five well-established German banking-houses in these countries which are doing a profitable business. There may be added money to the amount of £3,200,000, circulating in industrial enterprises, &c. The scene of the greatest activity is Guatemala, where £2,000,000 are invested in agriculture and other undertakings. Two railways, for the most part in German hands, have a working capital of £119,000, and a sum greater than this is invested in a lighting plant. The value of the Central American land in German hands is estimated at £3,617,000. Of this, 85 per cent. is in Guatemala, 12 per cent. in Costa Rica, and 3 per cent. in Nicaragua. The Germans also hold Government bond shares in banks, mortages, &c., making their total interest in Guatemala, Nicaragua, and Costa Rica £8,806,000, £2,094,000, and £1,905,000 respectively. About £333,000 are invested in Salvador, and £286,000 in Honduras. The total value of German investments in the Central American Republics may thus be estimated at more than £13,400,000.

General Notes.

Royal College of Art, South Kensington.—The premises of the Royal College of Art, under the Board of Education, at South Kensington, are being modified to meet the requirements of the reorganisation, which has been adopted by the Board upon the advice of the Council of Art. This Council consists of Sir William Richmond, R.A , Mr. T. G. Jackson, R.A., Mr. E. Onslow Ford, R.A., and Mr. Walter Crane. The Head-Master of the College is Mr. Augustus Spencer. Monsieur Lantéri is the Professor of Sculpture and Modelling, and the appointments to the Professorships of Painting, of Architecture, and of Design are likely to be announced shortly. The total number of students to be admitted to the College is 350, of whom 150 may be fee-paying students. The fee for each fee-paying student will be £12 10s. per term, and there are two terms in each session of twelve months. All students admitted (either free or on payment of fees) must have satisfied the Council of their ability to profit by the special courses of instruction, to provide for which the College has been divided into an Upper and Lower School. Students will be placed in one or other according to their proficiency: and will be required to pass through the four divisions of each school, namely, those for ornament and design, drawing and painting, modelling, and architecture. As part of the Upper School Course, technical instruction will be given at evening classes in a few of the following subjects:—Book illustaation, etching and lithography, stained glass, stone and marble-carving, wood-carving, mosaic, plaster and gesso-work, metal-work, shuttle-weaving, tapestry-weaving, embroidery, furniture and cabinet-work, pottery, &c.

School of Art Wood-carving.—The School of Art Wood-carving, Imperial Institute, South Kensington, has been re-opened after the usual summer vacation. Some of the free studentships maintained by means of funds granted to the school by the Drapers and Clothworkers' Company are vacant. The evening class is for the present closed, but to meet the requirements of those professionally engaged during the week, a special Saturday afternoon class is held. Forms of application for the free studentships, and any further particulars relating to the school, may be obtained from the manager.

Munich Art Exhibition, 1901.—Further information respecting the eighth International Art Exhibition to be held at Munich from June 1st to October 31st, has been received from the Board of Education, South Kensington. Works of art in painting, sculpture, architecture, engraving, and works of art-industry are admissible to the Exhibition. Copies (except drawings made for the engraver), photographs, and all works produced by mechanical process, anonymous works and works previously exhibited at Munich are excluded. First and second-class gold medals will be awarded by the Prize-Jury.

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FRIDAY, OCTOBER 12, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

SECTIONAL COMMITTEES.

The following are the lists of the Committees for the Indian, Foreign and Colonial, and Applied Art Sections, as appointed by the Council :—

INDIAN SECTION COMMITTEE.

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Sir Frank Forbes Adam, C.I.E.
Lionel R. Ashburner, C.S.I.
Jervoise Athelstane Baines, C.S.I.
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Prof. A. H. Church, M.A., F.R.S., F.C.S.
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B. Francis Cobb.
Alan S. Cole.
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DR. JOHNSON AND HIS FRIENDS AT THE SOCIETY OF ARTS.

Dr. Samuel Johnson was elected a member of the Society of Arts on December 1, 1756, and it is said that the only time he ever addressed a public meeting was in the great room of the Society.

He discussed a question of trade, upon which subject he considered himself to be an authority, and he afterwards wrote the preface to Richard Rolt's Dictionary of Trade and Commerce.

In his proposal form, Johnson is described as "A.M." Readers will remember that the man who quoted Macrobius to his astonished teachers, one of the most learned among whom declared that he had never known a freshman of equal attainments, left the University of Oxford without a degree. As Macaulay wrote, "the time drew near at which Johnson would in ordinary course of events have becomes a Bachelor of Arts, but he was at the end of his resources. Those promises of support on which he had relied had not been kept. His family could do nothing for him." He obtained the honorary degree of A.M. from his University in 1775, just in time for the letters to be printed after his name on the title page of the great English Dictionary, which first appeared in that year. Trinity College, Dublin, conferred the degree of LL.D. upon Johnson in 1765, and ten years afterwards he obtained that of D.C.L. from the University of Oxford. He never himself assumed the title of Doctor although that is now indissolubly attached to his name. Johnson was proposed as a member by James Stuart, who was usually known as Athenian Stuart, from his great work on the Antiquities of Athens. Stuart was enthusiastic and proposed many new members. Johnson's portrait was introduced by Barry in his picture of *The Society*, and his head appears between those of the two Duchesses of Rutland and Devonshire. The likeness is believed to be an excellent one.

David Garrick was a prominent member of the Society. When he was elected he was living in Southampton-street, Covent-garden, but afterwards he removed to the house on the Adelphi-terrace, which is marked by a memorial tablet. Johnson's fashionable friend, Topham Beauclerc, was also a member, and readers of Boswell's *Life* will remember the pathetic conversation between Johnson and his biographer respecting these two men there recorded: "We stopped a little while by the rails of the Adelphi looking on the Thames, and I said to him with some emotion that I was now thinking of two friends we had lost, who once lived in the building behind us—Beauclerc and Garrick. 'Ay, sir,' said he tenderly, 'and two such friends as cannot be supplied.'"

Goldsmith was not a member, but in 1760 he became a candidate for the office of secretary.

Of this candidature, Thomas Davies writes in his *Life of Garrick* as follows:—"He was told that Mr. Garrick was a leading member of that learned body, and his interest and recommendation would be of consequence to enforce his pretensions. He waited upon the manager, and in a few words requested his vote and interest. Mr. Garrick could not avoid observing to him that it was impossible he could lay claim to any recommendation from him, as he had taken pains to deprive himself of his assistance, by an unprovoked attack upon his management of the theatre, in his *Present State of Learning*. Goldsmith, instead of making an apology for his conduct, either from misinformation or misconception, bluntly replied, 'In truth, he had spoken his mind, and believed what he said was very right.' The manager dismissed him with civility; and Goldsmith lost the office by a very great majority, who voted in favour of Dr. Templeman."

John Forster, in his "Life of Goldsmith," comments on this interview. He writes:—"The manager might with wisdom have done more. The blunt reply in a generous man's interpretation, should at least have blunted the fancied wrong. It is painful to think that neither of these famous men, whose cheerful gaieties of heart were natural bonds for a mutual sympathy and strong alliance, should throughout life have wholly lost the sense of this unlucky meeting."

This is quite true as to the mutual relations of Garrick and Goldsmith, but it would have been impossible for a man of business, such as Garrick was, to vote for so unbusinesslike a man as Goldsmith, and he could not be expected to do such a wrong to a Society in which he was greatly interested, as to help him to obtain the Secretaryship, for which he was thoroughly unfitted.

If Goldsmith was not a member of the Society, John Newbery, the bookseller and publisher, for whom he probably wrote *Goody Two Shoes*, and certainly did write the *Vicar of Wakefield*, and several other works, was one.

Other well-known booksellers connected with the Society, who were intimate with Johnson, were Robert Dodsley and Samuel Richardson, one a poor poet and the other a great novelist, as well as prosperous tradesmen. Dodsley suggested in 1756 an enlargement of the scope of the Society, and proposed that it should be called, "The British Society for the Encouragement of Letters, Arts, and Manufactures." Johnson had a great esteem for Dodsley, but a poor opinion of his poetry. Speaking of *Public Virtue, a Poem*, he said, "This miserable poem did not sell, and my poor friend, Doddy, said 'Publick Virtue is not a subject to interest the age.'"

Boswell tells a curious story of an early meeting between Hogarth and Johnson at Richardson's house, when Johnson inveighed against the cruelty of George II. in ordering the execution of Dr. Archibald Cameron long after the Jacobite rebellion, in which he was concerned. At a later time he vindicated his action in quoting from Richardson by turning the attack upon Garrick himself. John Gilbert Cooper (who was also a member of the Society of Arts) related that "soon after the publication of his Dictionary Garrick, being asked by Johnson what people said of it, told him that, among other animadversions, it was objected that he cited authorities which were beneath the dignity of such a work, and

mentioned Richardson. 'Nay' (said Johnson), 'I have done worse than that: I have cited thee, David!'"

Another man of whom Johnson had a high opinion was Robert Dossie, the compiler of "Memoirs of Agriculture." Boswell tells us that he was well acquainted with him, and said on one occasion—"Sir, of the objects which the Society of Arts have chiefly in view, the chymical effects of bodies operating upon other bodies, he knows more than almost any man."

When Dossie wanted to become a member, as well as an editor of the organ of the Society, Johnson showed his generous consideration for a friend. In order to be able to give his vote for Dossie, he paid his subscription, which he had allowed to fall into arrear for two years.

Of other intimates of Johnson connected with the Society, special mention must be made of Sir Joshua Reynolds, Henry Thrale (the brewer of Southwark), and Dr. Charles Burney. The portrait of the latter in Barry's picture of *The Thames* was much remarked upon at the time it was first painted, owing to the incongruity of a wigged figure of a modern man appearing among the swimming nereids.

Richard Owen Cambridge, a famous wit of his day, sent Fanny Burney (Madame D'Arblay) these lines on her father's portrait:—

"When Burney's picture was to Gibbòn shown,
The pleased historian took it for his own;
For who, with shoulders dry, and powdered locks,
E'er bathed, but I? he said and rapp'd his box."

To which Barry is supposed to reply:—

"My lasting colours show
What gifts the painter's pencil can bestow,
With nymphs of Thames, those amiable creatures,
I placed the charming minstrel's smiling features:
And let not then, his *bonne fortune* concern ye,
For there are nymphs enough for you and Burney."

Several other members of the Society who belonged to Johnson's set might be mentioned, such as members of the Literary Club, not previously alluded to, viz., Sir Joseph Banks, Sir Robert Chambers, George Colman, Edward Gibbon, and Earl Spencer.

There were also those members who were at various times associated with Johnson, but can scarcely be considered as in his set, such as the Earl of Bute, the unpopular minister, who gave Johnson his pension; Horace Walpole, who never tired of satirising the great man; the Rev. William Mason, the biographer of Gray, of whom Johnson said, "Mason's a Whig." A Mrs. Knowles, not hearing distinctly, said, "What! a Prig, sir?" To which Johnson answered, "Worse, madam, a Whig! But he is both." Jonas Hanway, who offended Johnson by his dispraise of tea, and whose "Six Weeks Tour through the South of England" was wittily summed up in the sentence "Jonas acquired some reputation by travelling abroad, but lost it all by travelling at home;" and John Wilkes, whose name might perhaps have been added to the former list, for although Johnson disapproved of his conduct he was fascinated by the man. Of him he said "Did we not hear so much said of Jack Wilkes, we should think more highly of his conversation. Jack has great variety of talk, Jack is a scholar, and Jack has the manners of a gentleman. But after hearing his name sounded from pole to pole, as the phœnix of convivial felicity, we are disappointed in his company. He has always been *at me*; but I would do Jack a kindness rather than not. The contest is now over."

In the possession of the Society there is a small volume which contains the names of all the men referred to above, and of many more celebrities written by their own hands. Most of these signatures are clear and well written, but Samuel Johnson's neat signature is one of the best.

IRRIGATION IN INDIA.

[Major-General F. C. Cotton, C.S.I., has prepared the following supplement to an article by himself on the above subject, which appeared in *Blackwood's Magazine* for May last.]

The object of this paper will be to show, not only how the nation will be rescued from periodical famines and enriched by the water of its great rivers wherever it is carried, but at the same time how it will enhance the value of the railways on which so large a sum of money has already been spent.

Astronomers tell us that there are occasional spots on the surface of the sun which disfigure its usual brilliant and unbroken lustre. The earth has its periodical spots also. At this moment there is one disfiguring its surface in what ought to be its most brilliant portion— the British Empire.

I need hardly say I allude to the terrible famine in India, with which even the war in South Africa is in comparison a spot of far less magnitude on the surface of the Empire. In war the excitement of the struggle and the efforts to share in the deeds of heroism obliterate the soldier's suffering. In the famine, on the other hand, there is nothing but unmitigated misery continued from month to month, the war affecting thousands, the famine many millions.

In the case of the spots on the sun, the cause and effect are alike unknown, and we may leave them to those interested in astronomical inquiries. With the earth spot I am calling attention to, on the other hand, both the cause and effect are perfectly clear, and if the cause of the disfigurement can be reached, we are responsible for the spot's existence. A great responsibility it is, no less in the present case than the suffering of 80,000,000 of our own fellow-creatures, 60,000,000 being our fellow-subjects—6,000,000 of whom are seeking safety from death by starvation at the relief works, while the remainder are struggling

against utter desolation. Such is the effect, and I will not go into the details of the terrible visitation, as no words of mine could convey an idea of the horrors resulting from an Indian scarcity of food. The cause, I have said, is as clear as the effect.

The sole cause is the failure of the season's rain, as without water there can be no vegetable growth, upon which all animal life depends. Had there been no experience to prove it, there might have been a doubt as to whether any artificial supply of water could be a substitute for rain, in the growth of the crops of food on which we and our domestic animals exist. But this is no longer a doubt. And nowhere is this better seen than in the irrigated districts of India itself.

In the many districts in which this substitute has been brought into use by the wisdom of the Government, there the crops are unfailing, whether there is rain or not; and, as Lord Curzon expresses it, the "desert blossoms like the rose" even now, when but for the artificial supply of water all would be desolation and ruin.

If, then, we have water available, we have the means of removing the earth spot of famine wherever that water can be led.

As some of my friends in reviewing my former article have brought forward objections, or rather difficulties, in carrying out the utilisation of the water I refer to, I will begin this paper by answering them.

The first difficulty I have to answer is: that India is a poor country and cannot afford great expenditure. This opinion was also held some seventy years ago when the engineers were urging the extension of hydraulic works.

At that time it appeared to me that the engineering of the United States of America was better suited to India than the engineering of England, where money was more abundant, so I determined to go there, and I need hardly say, I found quite another view taken —the country as poor as India, for money there was none, and credit at low ebb, but the rulers were men of unlimited energy and determination, with statesmanlike views of the future. Their country must go ahead in spite of all difficulties, and the result has been that the States have become one of the great powers of the world with unbounded wealth.

The want of money and absence of credit was not to prevent the country being improved, and when I was there the Augusta railway was approaching completion without a cent of metal money being spent upon it. It could hardly be said that paper money was used, for the notes had no equivalent in money, but were good for so many tons carried so many miles on the railway when it was completed; and these notes being accepted by the people of the State, they answered the purpose of money.

I don't bring this fact to notice as one to be followed in India, but simply to show how difficulties are met by those remarkable people, who are acting still upon the same far-sighted policy, by spending millions on the Erie Canal while they take off all tolls and get no direct return for the money spent—the canal having no other object than navigation only. I must say I longed to carry such statesmanship as I saw there to the country I love so well in the East, and would have taken a Governor-General from America if I had had the power; but as that was not to be, India has not made the advance in the last sixty-five years that the United States has made under a more enterprising policy. Far be it from me to say that I wished to introduce any new system of government into India, for I have always felt and said, that in the absence of money and party influence there was no country in the world that had so perfectly pure and faithful a government as India during the thirty-three years I lived and worked in it from 1827 to 1860. The wants were statesmanship and enterprise, and the fact remains that while a famine is raging over 440,000 square miles of the continent, all the great rivers are pouring their flood-water into the sea. This, I maintain, would not have been the case if such policy as I found in America had been followed in India.

Another suggested difficulty is that the money spent on water goes out of one pocket and the receipt from the benefits comes into another, *i.e.* out of the Treasury, repaid to the nation. This expresses exactly the fault I find with the revenue officer's rule of India instead of the statesmen's.

What would my Yankee Governor-General have said to this? He would have said, in the language of that period: "Fill the coat-pocket of the nation, and I judge there will be no difficulty of replenishing the waistcoat-pocket of the Treasury;" and could he have contemplated what Lord Curzon said at Lyallpur as to the repayment of the whole cost of the Chenab works by a single crop, he might well indeed have laughed at this as a financial difficulty.

As to the actual difficulty of finding money in an over-taxed country like India, to this I can only answer that the same impossibilities were stated to exist before the railways were begun. It was said that there was no use of talking of improvement in irrigation or anything else, for there was no money for the purpose. But when the Government determined that railways must be constructed, more than £300,000,000 were found for the purpose. Where there is a will there is a way. Only let the Government determine that the water I write of shall not be lost, and the finance difficulty will vanish.

Another suggested difficulty is, that the lie of the land will prevent much of it from being watered—of course it will, and how much of the land has the benefit of the water will depend in a great measure upon the skill of the engineers. This I have pointed out, and if nothing is to be done because water cannot be led to all the whole surface of the country, nothing on a large scale will ever be done.

A fourth difficulty has been suggested, namely, "evaporation of half the water." The difficulty was also suggested by some one years ago, who

overlooked the fact that from time immemorial all the irrigation in India has been carried on in open channels. If half is lost by evaporation, it is the other half that pays, and, when rightly calculated by its benefits to the nation, pays enormously.

Another difficulty named is that many locks will be required. I don't understand this, but I suppose it to be with reference to the cost of the lock, which enables me to say a word on the subject.

Of course a weir and lock are only necessary for the improvement of the navigation of a stream, and it is not always understood that its cost should be considered as being the whole cost of many miles of navigable water. For instance, if there is a fall in a stream in which six inches to the mile has to be corrected, a weir having a fall of ten feet would affect twenty miles of navigation and be the actual cost of all those miles, affording a means of communication the cheapest to make, the cheapest to use, and the least expensive to keep in repair of any ever suggested.

There is also a set-off, if not an actual gain, on this expenditure in the water-power rendered available, for it must be remembered that where water is flowing on for irrigation nothing whatever is lost by the power exerted in its fall. And there is a clear gain wherever there is such a fall, having a large money value—a value much increased in the present day by its capability of being carried by an electric wire to almost any distance.

In my paper under review, I notice that in the Godavery system alone there are some fifty such falls of ten feet each, all of real money value of considerable amount. And it might be a good use to make of this great power to employ it in the haulage of the canal traffic by means of electricity, which is now used for that purpose in Germany without wheels or screw to cause a wash on the banks.

I have now, I hope, shown that these difficulties to be overcome in utilising the water of the great rivers are of no sort of moment, when considered with the enormous benefit to the nation set forth in my original paper. Not that I consider that any one or all of these supposed difficulties account for the water being allowed to run to waste. And I am justified in saying that no such difficulties, or indeed any, were set forth in the debate in Parliament, which resulted in a determination to leave things as they are. What reasons guided the majority on that occasion I am quite unable to say.

I must now answer two objections to the use of water which I have heard that seem not to admit of discussion, one indeed only to be whispered—all that I have hitherto mentioned being "difficulties," not objections.

The first of these objections is a fear that the water passing through the country will afford means of navigation which will compete injuriously with the railways on which so much has been spent.

The "whispered" objection to water, which I shall take up first, because it can be disposed of in a few words, is no less than the monstrous idea that as its effect would be to add to the prosperity of the country, it would add to the population, and be thereby a cause of difficulty in the future.

I should not have thought this notion worthy of any notice had I not seen an allusion to it in one of our leading journals, in which it is said that water had been suggested as a remedy for famine, but that this would only add to the produce, and, therefore, to the population, and the difficulty in the future. This horrible idea originated some some seventy years ago when some one was speaking of an existing famine, and said in a grim jest that, after all, perhaps, it was as well that the population of India should be kept down.

I would ask those who argue seriously in this way if they have any conception where this would land us. They can hardly realise that they are suggesting that India, under the British Government, should stand alone as the only civilised country on the face of the earth in which prosperity is prohibited.

While the rulers of all other countries are working for the increase of the happiness of the people, India alone is to have the best source of prosperity systematically withheld, making our sanitary law a sham, our relief works a mistake, and even the Mansion House Fund a mockery, as claiming a pitiable relief for a few thousands, while we look with complacency on the food for millions flowing into the sea, subverting the benign policy of England all the world over, which is filling the waste places of the earth with happy and prosperous peoples.

Lord Curzon, in his speech in aid of the Mansion House Fund, has offered to take a return ticket for any man of means to visit the famine-stricken districts, feeling sure that he would add liberally to the subscription when he returned to Calcutta.

I hope his Excellency will excuse me if I suggest his extending his offer, in the words of Messrs. Cook and Son, to those who hold these views, proposing a personally-conducted tour from Bombay, through the burnt-up country between that place and Lyallpur, with a fortnight allowed on the bank of the Chenab, there to hold a conference when the floods in the river are passing to the sea, to discuss the question whether the water is better there than in the country they have passed through, and whether it would be well and satisfactory as an act of government, either by action or inaction, that such a state of things should exist and continue under any circumstances whatever. And if any individual was still of opinion that nothing more was possible for the better condition of India, I can suggest no remedy for him but that he should be stripped of all he possesses to the last farthing, and take his place amongst the miserable millions at the relief works, with time at his disposal for a thorough reconsideration of the subject.

We have, I am thankful to say, good reason to hope that the Government has not adopted this inhuman notion, as the bold expenditure on railways is a proof of working on the opposite principle; for it is

fairly claimed for that splendid means of intercommunication that it will not only add to the increase of the prosperity of the country, and, therefore, add to its population, but will in cases of drought lessen the loss of life from starvation by the distribution of foreign food and the carriage of the starving to the relief works. And we may hope there never will be seen again such horrors as were witnessed in the Carnatic in 1832 and 1833, when the country was strewn with the dead, and it was not possible to know whether the death was the result of starvation, or of murder for the handful of food the victim had chanced to possess. We have, indeed, a more complete proof still of the Government working in the opposite direction in the magnificent works which have rescued millions in each of the districts watered, and there are—thanks to the enterprise of late years, and the skill of the engineers—many of those works in evidence.

I will now go into the subject of the other objection—the feared effect of the canals on the receipts of the railways.

It has never been officially or publicly stated that the palpable animus against the extended use of water for irrigation and navigation is the result of the great expenditure on railways. It cannot, of course, be declared, because to do so would at once admit that all the blessing very fairly to be expected from the railways was really inflicting the curse of drought on all the country which might have been rendered independent of the rainfall by the water now running to waste.

But I hear so much of the anticipated injury to the railways if canals are carried over so great a part of India, that I cannot ignore the fact that such a feeling exists, and as it does exist I must treat it as a fact. I am not sorry to have the question of antagonism between waterways and railways in India to discuss, because it is so clear that the influence of the £300,000,000 invested in railways ought to act in exactly the opposite direction. For, next to those who are ruined in millions by failure of a season's rain, there is no class so deeply interested in the artificial supply of water from the great rivers as those concerned in railway investments.

Water not only saves the county it reaches from periodical and oft-recurring ruin, but directly enriches it by its increase of production, increase of production on which the railways live. To any one who will carefully look into this subject it will be quite incredible that the railway interest should be opposed to the extended use of water; but the world in general is short-sighted, and it is only by studying each subject under consideration that it can be clearly seen.

What have we to guide us on this particular subject?

A writer in *Blackwood* for May on the management of English railways, who evidently, from every line of his paper, thoroughly understands his subject, says—"The fact admitted now by practically all railway authorities, that congested traffic does not pay, makes the treatment of canals by railway quiet inexplicable. The policy of Great Britain towards inland waterways is unique. In North America railway presidents are beginning to realise their value as a means of conveying cumbrous traffic which does not admit of any but a cheap rate. In Germany canals are carefully fostered despite the cheap railway rates, witness the recent attempt to connect the Rhine and the Elbe. In the United Kingdom alone we find that canals are being starved.

"It is true that ours is a small country, that our roads are excellent, our railways ubiquitous, and our seaboard suitable for coasting traffic. But this only explains how we are able to get on without canals, it does not justify their disuse."

This quotation, however, only refers to railway management, showing as it does that in any country, especially in as large a country as India, no railway system can be complete without the aid of water carriage.

The railways have the advantage of speed to offer, which never can be afforded by the canals. They have different duties to perform, and at all events any competition ends when the produce of the country is beyond the capacity of the railways, which is very limited, and very greatly reduced by the necessity for running trains at different velocities. The goods trains running at less speed must leave the lines clear for the dashing expresses, thus reducing the working times of the rails. The limit of capacity for carriage by a railway is soon reached, and if there is a difficulty in the carriage of "cumbrous goods" by the railways of England, it will not be difficult to see the utter impossibility of meeting the requirements of conveyance of the products of such a vast country as India.

As I have said, canals and railways as means of transport are altogether different. Railways are of incalculable importance where speed is requisite in the movement of troops and other passengers and valuable goods, or in anything where time is a consideration, and that is wherever there is affluence and prosperity. But railways are not and cannot be a cheap means of carriage. Speed is expensive, and there cannot be cheapness and high speed by any means of carriage.

I must also notice the utter inability of railways to save the life of the cattle of the country. These cannot be be saved by any importation or distribution of food. Food for them must be grown near at hand; and as a railway question, that is almost as important a consideration for the railway investors as for the cultivators themselves, for both are dependent upon the produce and prosperity resulting from it.

Whatever railways may do to save human life, the cattle must and do die now as they did in 1833, when a villager of the Carnatic told me that although they had stripped all their houses of the thatch to feed them, they were all gone—the cattle dead or dying

now affording a curious commentary upon our mercy and consistency when, to prevent cruelty to animals, we punish with fine or imprisonment the costermonger for ill-treating his pony, while we allow the whole of the domestic cattle of that area to die a lingering death by starvation without a thought for them. In short, the railroads may be credited with mitigating the fatal effects of famine, but they have not done, nor can they ever do, anything to make up for the missing rain, as water from the rivers does so perfectly.

It has been well said that there is a famine of wages. No doubt there is, the remedy for which is to give water to the land and make cultivation possible, when the labourer would earn his wages as certainly as if the rain had never failed.

But my greater point at this moment is to show how water used for irrigation, navigation, and power, &c., will, by enriching India, benefit the railways, and give an entirely different value to the money that has been invested in them.

I must once more appeal to our American friends —the most successful nation-makers the world has ever seen—and I am fortunate in having had a copy of a periodical lately sent to me from Albany, *The Quarterly Journal of Economics* for February of this year, in which there is a very valuable paper upon the New York State canals.

From this paper it is clear that the same policy is followed now that was adopted before my visit in 1835, the leading principle being the advancement of the nation by fostering and encouraging to the utmost its industries.

After giving an account of the fluctuations in the traffic on these canals, the writer goes on to say what it is now proposed to spend on a canal which has no other purpose than navigation, or what in India would be only considered direct competition injurious to the railways. How differently this is estimated in America, where those most shrewd of people see that they cannot go wrong in enriching the whole nation !

The writer informs us that a committee is considering which of two great expenditures it would be advisable to make: one on improving the old Erie Canal at a cost of 21,160,000 dollars, or on still further improving and enlarging the waterway at the cost of 59,000,000 dollars; and he goes on to say that the capacity of the canal, as enlarged under the smaller project, would be 10,000,000 tons a year, and on that tonnage of through freight the saving in cost of transportation as compared with the present canal would be 4,300,000 dollars per annum. The capacity of the larger canal would be over 20,000,000 tons a year, and on that tonnage the saving in cost of transportation, as compared with the present canal, would be 12,200,000 dollars per annum.

"Comparing these figures with the estimates for cost of construction, it is seen that either improvement, even if less than half of the maximum tonnage is secured, will make possible a direct reduction in cost of transportation much more than the outlay for the improvement; while in addition New York State would gain indirect and immeasurable advantages by the development of its commercial and industrial activities."

This, it must be remembered, is in a country with the most perfect railway system, upon which vast sums of money have been expended—and no people in the world would be more careful than the legislators of the United States not to injure such an important industry as that.

They know that in all they are doing to enrich the State, the railways will have their full share in the benefit. I must here ask, what would the legislators of New York have said had they been able to claim, as additional return for their great expenditures, the manifold greater profits to the country from irrigation, as would be the case in India ?

And I may also ask, what would have been the result of Captain Arthur Cotton's attempt to raise the Godavery district from its depressed condition if he had spent his two and a half millions on rails when there was no produce to move, or well-to-do people to travel ? And if he had made that mistake, how could he have better corrected it than by spending another two and a half millions exactly as he did in giving to the delta the most perfect system of hydraulic works, with the result of loading the country with products to be moved, and affluent people to travel ?

It is quite true that the cheaper products would be carried on the canals, but no one can doubt the life that would be given to the railways under the changed condition of the country. Would it not be the same in all parts of India to which the enriching effect of water could be carried ? I only ask my readers to look into the matter themselves, and I am confident that they will agree with me, that robbing the country of its cheap carriage to the crippling of its prosperity is a "Goose with the golden egg" policy, abandoned by every other nation.

And while on this subject I must point to the curious if not significant fact, that while so much is doing all over the world to enrich countries by the use of inland navigation, nothing is ever said now of the use of Indian water for this purpose. Indeed so marked is this that the word navigation would appear to be a prohibited word. And yet it is in so many great countries the sole use to which the water is put. It can hardly be that this is an oversight in India. But it may not be generally understood that cheap carriage has the effect of adding to the value of every article that has to be conveyed to a market,—the more distant the market, of course, the greater the addition, the saving of loss by the cost of carriage being the real increase in value.

It is with a view to this increase in the value of the assets of a country that the United States and so many other great nations are now spending money on the means of carrying by water; and every one may understand the addition that would be made to all that is transportable in India by reducing the cost of

its long inland transport. The sum, if it could be expressed by figures, would be found to be enormous, and it is this that is the Bank of Wealth the railways will have to draw upon as the waterways are extended.

Nor is it on the articles now moved only that the value is increased, for cheap carriage makes much saleable that is, when unmoved, valueless. To give a single instance. The district of Tanjore in the Madras Presidency is a delta, and like other deltas, without a particle of stone. The neighbouring district of Trichinopoly is poor and rocky. It was found that by means of one of the canals the stone could be cheaply carried from the poor district to the rich one, and the obtrusive rocks of Trichinopoly became a saleable article. The magic of cheap carriage had made them precious stones.

There is no one who can deny that where there is water under control, it would do far more for the country watered than even the usual fall of rain could do. Nor can any deny the fact that there are great rivers flowing from the more or less high interior directly across the continent of India, the flood-water of which is entirely at our disposal, as if to guard the whole country from the effects of failure of rain.

For those who have no personal acquaintance with the Indian rivers, as well as for those who are inclined to belittle the quantity of water now lost, I must explain that the rivers I am writing of are not such as the Thames at Teddington, but mighty streams which discharge great volumes into the sea in their seasons of flood, all of which, as I have said, are at our disposal.

There are six great rivers in India, viz., the Ganges, the Mahanuddy, the Godavery, the Krishnah, and the Cauvery on the east, and the Indus on the west, all of which for some months of the year are in flood —the water flowing into the sea.

Of these six rivers I will take the Godavery as my example, as it is fully described by Mr. Walsh in his report on the delta works, of which he had charge for many years. It is a good example too, because it is altogether independent of the snow-clad mountains of the north, which some would have us suppose were the only certain sourse of supply—while in fact they only affect the Indus and the Ganges. All the other four great rivers above-named have quite unfailing floods of some four months' duration, flowing to waste.

Even the Cauvery, which is the smallest of the great rivers, and one that might very naturally be supposed to depend upon local rain and to be but poorly supplied, never fails to have even in the driest year a heavy flood passing into the Bay of Bengal.

Mr. Walsh says of the Godavery: "The Godavery takes rank amongst the great rivers of India next after the Ganges and the Indus. Rising some 70 miles north-east of Bombay, and only 50 miles across the Peninsula, till after a course of nearly 900 miles it falls into the Bay of Bengal, about 250 miles north of Madras, it receives the drainage from 115,000 square miles, an area greater than that of England and Scotland combined, and its maximum discharge is calculated to be 1,500,000 of cubic feet per second, more than 200 times that of the Thames at Staines, and about three times that of the Nile at Cairo."

As many of my readers may not be in the habit of estimating quantity by millions of cubic feet per second, I would ask them to try and realise the flood of water passing over the weir at Dowlaishwarm, at the head of the Godavery delta, from June to October, when a heavy current $2\frac{1}{4}$ miles in breadth is flowing night and day into the sea, while the whole of the canals of irrigation are filled for the cultivation of 700,000 acres of rice, without—at that season—making any appreciable diminution of the flood.

It is this vast flood in all the rivers named that I claim, as far as the skill of man can utilise it, for the reduction of the periodical famines, the enrichment of India, and, I must add, the success of the railways already constructed, declaring as I do that in these rivers we have the remedy for famine and poverty of India generally.

What gives these rivers their permanent supply of water is that they are not single streams, but the gathering together of many great rivers as tributaries draining different tracts of country so large, that some are sure to have a supply when others fail, and so it is that the floods are unfailing though they must differ in quantity each year.

To make this more clear, I may state that when I was exploring the upper Godavery I passed the junction of two of its great tributaries which were neither of them yet in flood, and I had no idea till I returned to the delta that a most unusually high flood, to which they had not contributed, was passing over the weir and running into the sea.

I am quite aware that, to make the best of this stupendous treasure, the highest skill of the engineers will be required, and although the profession has sustained the great, but we must hope the not irreparable, loss to India of that most eminent engineer and devoted man, Sir Arthur Cotton, I cannot doubt that the necessary skill will be found when the word goes forth that these waters must no longer be lost.

When Lord Dalhousie was at the end of his prolonged Governor-Generalship, he told me that nothing had astonished him more in India than the energy and faithfulness of the corps of engineers, who never failed to fight the battle for the improvement of the country, though all they fought for would bring tremendous labour and responsibibity upon themselves with not the slightest profit or promotion. This will, I hope, be always said of the hydraulic engineers of India, whether military, as they were then, or civil as they are now. And I should not be true to my profession if I did not thus protest against the loss of India's greatest need.

English engineering never stood higher than it does at present, and certainly Englishmen have never given

better proof of their determination and faithfulness than they have in the last six months. There has been no change in them since Lord Dalhousie's day.

I have explained how great is the value of the unbounded floods of water we possess, and to ignore them is to rob India of a treasure greater than the gold of Africa. Gold mines will be worked out, but so long as the sun shines to raise clouds from the ocean, so long will the floods of the Indian rivers repay the dividends in money and blessings of all sorts on the expenditure on hydraulic works.

And by these means those earth spots will be reduced to a minimum, which now, in oft-recurring periods, disfigure, so inexplicably and so unnecessarily, the surface of our Indian Empire.

TRADE OF BOMBAY, 1899-1900.

The total value of the foreign trade of Bombay in 1899-1900 was Rx. 78,552,466. This amount is smaller by Rx. 2,148,820 than the trade of 1898-99, but the disastrous famine in Western India suffices to explain the diminution. The failure of crops not only prevented the usual large exports of grain and raw cotton, but necessitated their importation. Germany and Austria-Hungary increased their exports of apparel to India, Austria having a monopoly of the trade in Turkish caps. Cheap English boots and shoes are preferred to the native articles in all parts of the Presidency. English second-hand carriages find a ready sale in India. Imports of clocks and watches are growing, but the demand is mainly for cheap and often worthless watches, which are mostly of Swiss manufacture. A greater quantity of English coal was imported last year, notwithstanding its price, while Japanese coal, which is cheap and transported at low rates, was also imported in larger quantities mainly for use in cotton mills. Most mills, however, now use Indian coal, as do the great Bombay railway companies. In spite of high prices American cotton was largely bought in order to allow Indian mills to continue working and meet their contracts. This cotton came largely from the United Kingdom, on account of the facilities of transport and financing which the English trade enjoys. English yarn was imported in larger quantities, as local weaving mills were trying to compete with English piece goods, the grey varieties of which have fallen off, while low and medium white goods, especially nainsooks, show a considerable increase. But the chief growth was in coloured cottons, which advanced 44 lakhs. Owing to the use of alizarine and other dyes, English and Continental manufacturers have cheapened production and are ousting native dyed and printed goods. Barcelona is developing an export trade in cotton undershirts. Several Indian merchants have established themselves in Japan, and are actively pushing the trade in glassware and earthenware, to the prejudice of Chinese, Belgian, and Austrian producers. Imports of ale and beer improved, and English brewers are cutting out their German rivals; but the Germans are sending cheap whiskey to replace the declining imports of brandy, which, owing to adulteration, has lost favour. Imports of raw silk and silk piece goods have declined, largely on account of high prices, which were due partly to a short crop in China, and partly to the large demand in Europe caused by the Paris Exhibition. The Exhibition was also responsible for greatly increased imports of pearls from the Persian Gulf for re-export. In stationery England is now competing successfully with the cheap products of Germany. The protection afforded to cane sugar by the imposition of countervailing duties on bounty-fed beet sugar has induced Java to compete in the Indian market, and the Dutch colony may prove a formidable rival to Mauritius. The sale of shoddy Japanese umbrellas has declined, English umbrellas being now considered the cheapest and the best. The re-export trade which Bombay has so long conducted between Europe and the Persian, Arabian, and East African coasts declines steadily with the advent of direct steamers. Cotton piece goods constitute by far the most important item in this trade. One-third of the re-export trade is with Persia, but this has been affected both by direct communications and by the competition of foreign nations, Russia having encroached on Northern and Central Persia with her cotton goods, and Germany and other countries on Southern Persia. Turning to exports of Indian produce and manufactures, we find that Japan and China together took 67 per cent. of the raw cotton shipped—their purchases increasing while those of European countries declined. An interesting statement is given to show the growth of the Japanese cotton industry in the last few years. In 1892 Japan took 8,336,388 lbs. of yarn from Bombay, and 431,109 cwts. of raw cotton from India. In 1899 the former had sunk to 100,000 lbs., while the latter had risen to 2,607,448 cwts. Japan takes a diminishing quantity of raw cotton from China, but a fast increasing supply from the United States, besides drawing more on other countries. American cotton threatens to replace Indian in 20's and higher counts, but cannot compete in 16's and lower counts. In 1899 Japan had 1,103,459 spindles, or more than three times the number in 1891. Exports of Indian cotton yarn from Bombay increased, mainly owing to reckless speculative business with China, and China took also more grey piece goods of the higher counts. Exports of Indian cottons to Madagascar have declined through the heavy protective tariff levied on all goods not of French origin. There were larger exports of woollen carpets and rugs, which go mainly to the United States. A feature of the year's trade was the importation of Rx. 1,580,418 in Japanese yen, which the banks found it profitable to sell to Government. —*The Times.*

*RESULTS OF EXPERIMENTAL WORK IN AGRICULTURE IN CANADA UNDER GOVERNMENT ORGANISATIONS.**

For some years prior to 1884 agriculture in Canada was in a depressed condition, and during that year a Select Committee was appointed by the House of Commons to inquire into the best means of encouraging and developing the agricultural industries of Canada. From the investigations of this Committee it was shown that farming in Canada was at that time in a very defective condition, that there was a lack of thorough tillage, that no sufficient measures were taken to maintain the fertility of the soil, that there was a want of knowledge in regard to rotation of crops, and of the selection of improved varieties of seed; that lack of information existed also in reference to many of the principles underlying the successful rearing of stock, the manufacture of dairy products, and the growing of fruit.

This Committee recommended that the Government establish an Experimental Farm where experiments might be carried on in connection with all branches of agriculture, horticulture, and arboriculture, and that the results of these experiments be published from time to time and disseminated freely among the farmers of the Dominion.

In 1886 an Act was passed by the Parliament of Canada authorising the Government to establish a Central Experimental Farm and four Branch Experimental Farms in different parts of the Dominion, and during the two years following these farms were established and set in operation. The results of twelve years' experience have shown that these institutions have been highly beneficial to the farming community. Experimental research has been carried on along the lines prescribed by the Act by which these farms were established, and much information has been accumulated and distributed freely to the farmers of Canada in reports and bulletins. Benefits have thus been conferred on Canadian farmers in connection with all the more important farm crops, in the development of the stock and dairy industries, in the production of fruits, in the growing of trees for shelter and timber, and in the advancement of other branches of arboriculture.

Much attention has been given to experiments relating to the maintenance of the fertility of the land, to the best methods of cultivating the soil, to a proper rotation of crops, to the best time for sowing, and the selection of the best and most productive varieties for seed. By freely spreading the information gained, supplemented by a liberal distribution of samples of the best and most productive cereals, crops have been improved, and the attention of farmers generally awakened to the importance of adopting such measures as will result in increased crops. The steady advancement which has taken place within recent years in Canada, and the increasing prosperity of agricultural industries, may in large measure be attributed to the useful work of these Experimental Farms established and maintained by the Government in different parts of Canada.

* Abstract of a paper read before Section F of the British Association at Bradford, by William Saunders, LL.D., Director of Canadian Experimental Farms.

MEMORIAL TABLETS AT BATH.

In emulation of the work undertaken by the Society of Arts in London, some attention has been paid of late years in various parts of the country to the erection of memorial tablets to mark the houses where distinguished men and women have lived. A remarkable instance of this has just occurred at the City of Bath. Memorial tablets have been placed on the houses inhabited by the two architects, father and son, to whom the beauty of Bath is mainly due. One of them is on a house at 24, Queen-square, where the elder Wood lived, and the inscription runs, "Here lived John Wood, B. 1704, D. 1754." The other, to the younger Wood, is at 48, Gay-street, and is inscribed "Here lived John Wood, Jun., B. 1727, D. 1781." These tablets were unveiled on Thursday, September 20, by the President of the Royal Institute of British Architects, with a certain degree of public ceremonial. Mr. Emerson paid an appropriate tribute to the genius of the Woods. He remarked that the elder grasped the problem of the laying out of the city, having the foresight to see that the lines must be laid down at the very beginning in wide streets, open spaces, and good squares. Many of our towns, he said, particularly the metropolis, had been absolutely spoiled by the want of that foresight. Mr. John Wood, jun., was the worthy son of a worthy father. He worked for a number of years in conjunction with his father, and was responsible for that very street of which they were at the corner (Gay-street) and the Circus. He also built the Assembly-rooms and the York House Hotel, and a number of other buildings. Whether he was equal in greatness to his father was, he thought, a question that he need not go into, but, at any rate, both he and his father did some very beautiful work for their city of Bath. One thing which the Woods did in conjunction with Ralph Allen was of extreme utility, and that was the re-opening of the Bath stone quarries, and the building first of all of Prior-park. The re-opening of those quarries gave facilities to carry out all their works in the city by both the Woods, and from a commercial point of view, the city should be thankful to the Woods and to Ralph Allen for that. It was rather wonderful when they thought that those architects of 200 years ago, without the advantages of research and travel, and without the books on architecture which were available to-day, were able to build and conceive such a scheme as the laying out of the city of Bath, and to erect such beautiful buildings as there were in the city, doing work which was certainly not inferior to that of

the eminent architects of that day. It was a lesson to architects of the present day, who had the advantages of research and travel, to find that they did not always come up to the beautiful buildings which they saw in that very square.

LIGHT RAILWAYS IN NATAL.

A late number of the *Board of Trade Journal* contains a notice of this subject from "Industries," a journal published in Natal. It is stated that few have any idea of the extensive use made of light railways in that colony, or the relative cost of this means of transport compared with the old methods. There are not less than 175 miles track of 12 lb. to 20 lb. rails laid down; the gauges varying from 18 ins. to 30 ins.; and this length of line is constantly being increased. These 175 miles track have to serve over many hundreds of miles. Take the Tongaat Sugar Co., Ltd., for example. This estate possesses 22 miles of track, 8 being permanent and 14 portable. These 14 miles of portable track are placed once a year over the whole of the 180 miles of roads cut through their cane fields. The gauge used on this estate is 24 in. gauge, which the majority of the planters consider most suitable for cane transportation. When animals are used for drawing the trucks the 12 lb. rail has proved itself to be the most suitable section; but where steam traction is employed, 16 lb. rails are preferred. For heavier work than that on sugar estates, 16 lb. rails should be used for animal, and 20 lb. rails for locomotive traction. Four miles of 16 lb. rails are used on the largest Wattle farm in the colony; the poles being carried on a dozen two-bogie trucks, the construction of which has been slightly altered to suit their special requirements. The following particulars may be of value to those intending to adopt this expeditious and economical method of transport:—

With sleepers	2½ ft. apart.		3 ft. apart.
12 lb. rails can bear a wheel pressure of. .	1,630 lbs.	....	1,430 lbs.
16 lb. rails can bear a wheel pressure of. .	2,360 ,,	....	2,050 ,,

Thus, by increasing the number of wheels to a locomotive it may be utilised for working on 12 lb. rails. Take, for instance, the most common style of track—12 lb. rails and sleepers three feet apart. A four-wheeled locomotive with a total wheel pressure of 7,000 lbs. would be too heavy for working on it; whereas, by the addition of another pair of wheels there would be over 1,500 lbs. to spare. It would appear that much economy can be effected by planters investing in light railway plant.

When the steel market is normal three miles of track and a dozen trucks of the above type—six with brakes, six without—constructed to carry 3,000 lbs. of sugar cane, can be purchased at under £1,000 delivered. With regard to the outlay of the planter who employs the regular type of ox waggon seen on the plantations, the waggons cost him £20 each, and carry about 2,000 lbs. Therefore, to transport as much cane as the twelve trucks mentioned above would carry, he would require 18 waggons, at a cost of £360. He will require four oxen per cart, viz., 72 oxen, but as some of the oxen are always lame, or sick, he cannot work his 18 carts without keeping at least 80 oxen, which, putting the cost of the oxen at only £8 a-piece, would bring up the outlay for carts and oxen to £1,000. Beyond this is the fact that far more work can be done with a tramway than with the old system of carts.

The uses of light railways are not limited to sugar estates. Contractors, brickmakers, &c., are large users, for they find that with rails and side-tipping trucks they can turn out far more work than hitherto accomplished and at much less cost.

"Industries" adds that, in the course of the next few years it is possible that many of the large farmers in the colony will be making use of this economical method of transport for manuring their lands, carrying their crops, &c.

IDENTIFICATION OF FIBRES.

While a great deal has been published on the identification of the different fibres in commercial use, much of this has not had a truly commercial aspect. It is frequently difficult to identify a fibre from the description given in commercial text-books, especially where fibres closely resembling each other are examined under a microscope after the ordinary treatment or mount.

A writer, in speaking of the microscopical identification of some useful fibres, says that the separation of the ultimate fibres by teasing is tedious, and often leads to a very unsatisfactory mount. The best way is to remove by chemical treatment the resins cementing the ultimate fibres into the filament. This is more difficult with some fibres than with others, those having a high content of silica being usually the most refractory. In this particular, sisal and manila are the most noteworthy.

In a commercial laboratory, where results should be obtained as quickly as possible, a quick temporary mount has to be made which will show the characteristics of the fibre necessary for identification; and in order to prepare the fibre for such a mount, a suitable chemical treatment not occuppying too much time is a great desideratum. The best method consists in boiling the fibre in a 2 per cent. solution of caustic alkali, washing and suspending the fibre in water, and passing a stream of chlorine gas through it until it is thoroughly bleached and the gums thoroughly destroyed. This may also be done by placing the specimen in a solution of chlorate of potash acidified by hydrochloric acid. At this stage the filament is entirely destroyed, but the ultimate fibre retains the form of the filament. The material is then rinsed in alcohol, and mounted in Canada balsam in the usual

way. After this treatment there should be no difficulty in teasing out the ultimate fibre.

The fibre may then be examined under a microscope or micro-photographed. The best method for the examination of fibres is with artificial light, using a polariser. The joints or markings on the fibre seem to have a different rotatory power, or at least they are brought into a more distinctive effect in relation to the rest of the fibre. This is also true in photographing, and the best photographs have been obtained by using an arc light and polarising the rays. The markings are more distinctly brought out when the analyser and polariser are in such relative positions that the background or field is almost totally dark.

To distinguish between sisal and manila is one of the hardest problems of fibre identification, but little trouble has been found after treating the fibres in the manner described above.

The characteristic appearance of manila is very much enhanced by the chlorine treatment, and the same is true of sisal. The sisal is very much coarser than manila, and tapers considerably more; when properly prepared the dark centre is seldom apparent. It has, however, after the treatment mentioned above, peculiar markings, having transversal cross-markings which appear to form X's upon the fibre.

The peculiar formation of the cotton fibre is so distinctive as to need no comment. Wool, with its peculiar scaly appearance, is also very distinctive, and where wool and cotton are found together they are readily distinguished by an ordinary mount. The above treatment has never been tried on animal fibre, for the reason that nothing would be gained.

Silk is also distinctive; it is quite even, but occasionally little nodules are noticed in the side of the fibre, and for this reason it is not as regular in width as manila. It has apparently no markings, and its ultimate fibres are also its filament.

Among the textile fibres the most difficult to distinguish one from the other are flax and ramie. They are used in the same class of work, when ramie is used at all, and have the same general microscopical appearance. Ramie, at first sight, looks very like flax, although, upon a minute examination, a difference will be observed. The ultimate fibre of ramie is usually coarser, the bamboo-like joints are larger and more marked, and have quite a different appearance from that of flax as seen with a moderately high-power glass.—*Textile World*, Boston, Mass.

PARAGUAYAN FRUITS.

Guava is one of the most abundant of Paraguayan fruits. There are immense numbers of trees throughout the country and women bring the fruit in bushel baskets to Asuncion. It is a yellow-skinned fruit about as large round as a five shilling piece and contains many small seeds. The tree looks like a plum tree and yields about one bushel and a half. The guava season is from January to April and commences again in August. This fruit, says the United States Consul at Asuncion, makes a delicious jelly, clear and light red in colour. The fruit is also used to make paste. Naranjitas, or small bitter oranges, produce excellent preserves. They are about the size of a lemon. The bitter taste is removed by immersion in running water, and the orange entire—skin and pulp—is preserved. This orange is said to hold the flavour much better than the sweet variety. Three years after planting the tree is ready to bear and it sometimes bears twice a year. The lemon, or limon as it is called in Paraguay, is not found in as great abundance as the naranjita, but is also of extensive growth. It is not quite as large as our lemon and is preserved entire like the naranjita. The lemon tree produces from two to three bushels. Aguai is a most delicious fruit, the size of a plum, with two or three shiny seeds. The tree is the size of a large apple tree and yields about four bushels. Many are found in the vicinity of Asuncion, especially in the town of Lambare, also in Campo Grande. Abacaxis is a kind of Brazilian pine apple that has been introduced into Paraguay and grows abundantly. It is very juicy and exceedingly sweet. It is stated by experienced persons in Paraguay that the abacaxis when preserved will retain its flavour and remain fresh for years.

General Notes.

Indigo in West India.—Mr. Alexander Rogers has received from Bombay the following further information respecting the produce and price of indigo (see his letter on this subject *ante* p. 459):—"There are four cart-loads (a cart-load is 15 Bengal maunds of 80 lbs. each) produced in an acre. If the soil is good and the rainfall favourable it may come to 18 or 20 maunds of indigo. Some times only about 10 lbs. are obtained, the average being 15 lbs. The price is from rupees 55 to 59 per small maund of 40 lbs., but in a year of scarcity, such as last year, the price may go up to as much as 80 rupees."

Locust Destroyer.—In reference to Dr. Munro's paper on the locust plague, read at the late meeting of the British Association (see *ante* p. 814), it may be noted that the experiments in the destruction of locusts at the Grahamstown Bacteriological Institute have been very successful. The result of these experiments has been to show that by creating what is called "Locust Fungus" whole swarms of locusts may be destroyed. With a few tubes of fungus five swarms were destroyed in four days and 15 more in the next ten days; that is to say, hundreds of thousands of these creatures were destroyed before they had been able to inflict any injury. It is stated in the *Board of Trade Journal* that these discoveries have created much interest at Naples, and though locusts are not the plague in Italy that they are in Africa, they are bad enough to make it highly desirable that so easy a remedy should be applied in that country.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

PRIZES FOR DESIGNS FOR FURNITURE.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in Prizes to "Students of the Schools of Arts who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1901, when six prizes will be offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

Proceedings of the Society.

CANTOR LECTURES.

THE INCANDESCENT GAS MANTLE AND ITS USES.

By Vivian B. Lewes.

Professor of Chemistry, Royal Naval College, Greenwich.

Lecture I.—Delivered May 7th, 1900.

Great as has been the advance in incandescent lighting in England during the past eight years, we are still much behind Continental practice, and whereas in many towns in Germany from 80 to 90 per cent. of the gas burners are of the incandescent type, in London the percentage would hardly reach 20. This is largely due to the ability with which the English Welsbach Company have hedged around their great monopoly, and have kept up the price of burners and mantles; so that although in Germany you can buy an incandescent burner and mantle for a mark, it costs the English consumer 4s., and the fact that a union jet nipple can be obtained for a penny compensates with a very large class of consumers, for the fact that they obtain only one-tenth the amount of light from their gas that the larger outlay would render possible.

All burners owe their light-giving powers to incandescence, and the gas flame which emits light because of the glowing particles of carbon within the envelope of the flame has just as good a claim to the use of the term "incandescence" as the mantles which the term always now conjures up in our minds, the principle of which consists of consuming the coal gas in an atmospheric burner with a non-luminous flame, so as to obtain the maximum amount of heat. They merely replace the carbon particles by finely divided rods or threads of non-combustible oxides, with a greater power of emitting light when heated to a given temperature than the original carbon particles possessed.

Producing light by heating refractory bodies to incandescence is entirely an outcome of the 19th century, and dates from 1826, when Drummond first showed that a piece of dense lime could be raised to intense incandescence by the heat of the oxy-hydrogen blowpipe flame, the lime at later dates being replaced by buttons or discs of magnesia and also by zirconia. When using a comparatively large mass of material, as was done in these earlier experiments, the temperature needed to secure incandescence was above that which could be obtained by the use of air as the supporter of combustion, and it was a considerable step forward when it was realised that by attenuating the body to be heated, and choosing a highly refractory material of low conductivity, an ordinary flame could be made to give the temperature which with the larger mass had required the use of such costly appliances as the oxy-hydrogen blowpipe.

Even before the middle of the 19th century the general principles upon which the incandescent mantle of to-day is based were known, for we find that Talbot, in an article on "The Nature of Light," published in the "Philosophical Magazine," in 1835 (iii. 114), stated that

"Paper soaked in a solution of chloride of calcium, and burnt in the flame of a spirit lamp, leaves a white network of ashes, which, when held in the feeblest alcohol flame, emits a brilliant light."

This experiment contains the germ of incandescent gas lighting and embodies the principles adopted at the present day, namely, the saturation of a natural combustible fibre with the salt of a metal, burning off the organic matter, and leaving a skeleton of the oxide of the salt of the metal used, in so finely divided a condition that when subjected to the heat of any ordinary non-luminous flame it becomes incandescent.

Four years afterwards Cruickshank took out a patent for a cage or mantle of fine platinum threads woven together, and of such a shape and size as to thoroughly envelope the outer portion of the flame which causes its incandescence. Cruickshank, however, noticed that the luminosity of the wire was not so great as that emitted by heating the oxides of certain metals, and attempted to increase the light emissivity by coating the platinum wires with a paste of such oxides, but without much success, as it was found impossible to make the paste adhere to the surface of the wires for any length of time.

In 1848, Gillard first put the manufacture of water-gas on a comparatively successful footing by introducing the principle of raising carbonaceous material to incandescence in a cupola furnace by an air blast and then injecting steam to form the water-gas until the temperature fell, when the steam was cut off and the fuel again "blown" up to the necessary temperature to make water-gas once more, a process which is the basis of all modern water-gas practice.

Water-gas, consisting of nearly equal volumes of hydrogen and carbon monoxide, burns with a non-luminous flame, and desiring to utilise it for lighting purposes, Gillard devised a cap or mantle of fine platinum wire, which was suspended in the flame and heated to incandescence. For some months this method of lighting was in use at Passey and Narbonne, but the trouble which has wrecked all attempts to utilise mantles of platinum soon showed itself, and the light emitted by the metal filaments rapidly grew less and less under the influence of the burning carbon monoxide, and finally the mantles became so brittle that they fell to pieces.

In 1849, Frankenstein introduced a lamp in which the flame from oil or spirit was caused to heat to incandescence a netted fabric, which was coated with a thin paste of magnesia and lime mixed with gum arabic. Owing, however, to the materials being merely pasted upon the fabric and not soaked into it, these mantles were very fragile and had no durability. Indeed, it is an impossibility to make a mantle exactly according to the instructions given by Frankenstein, who, as was afterwards explained by Werner, really mixed with his ingredients a little common salt, whereby some of the oxides were converted into soluble chlorides. These soaked into the fabric and so rendered the manufacture of the mantle possible.

So far the work done had been to establish the form of the mantle, and the principle of obtaining the material in a sufficiently fine state of division to become highly incandescent at the temperatures given by an ordinary flame, whilst Talbot had clearly indicated the way in which this might be done.

The only non-luminous flames available up to this period were those of the spirit lamp and water-gas, but at this epoch Bunsen, the greatest of Heidelberg's great men, was planning and fitting those laboratories which have since then given so rich a harvest to the scientific world; and while considering the methods of heating which should be adopted on the working benches, his attention was called by one of his assistants—now Sir Henry Roscoe—to the then novel contrivance of a non-luminous gas burner. Seeing at once the enormous convenience of such a source of heat, Bunsen brought his marvellous manipulative skill to bear upon the subject, and in a few weeks gave the world the "Bunsen burner"—a burner which has done more for the gas industry than almost any discovery or invention connected with it, which has made coal-gas available for fuel purposes, and has enabled it in conjunction with the incandescent mantle to hold its own against the threatened rivalry of the electric light.

The next step of importance in the history of the incandescent mantle was the replacement of lime and magnesia, which up to this time had alone figured as constituents of the attempted mantles, by oxides of a more refractory character, having the property of emitting a more intense light at the available temperatures.

In 1852, Bergemann noticed that oxide of thorium when heated to incandescence emitted a beautiful light, while in 1863 Bahr, when heating nitrate of erbium upon a platinum wire, observed that it swelled up and left a

residue of oxide, which emitted a brilliant greenish light. He communicated this result to Bunsen, and they made a joint investigation of the subject, the results of which were published in Liebig's Annalen for 1864, where they pointed out that the oxides of the yttrium group of metals, when heated to incandscence, emit a beautiful light of great intensity.

In 1878, Edison patented the idea of coating platinum wires with oxides of such metals as zirconium and cerium, the materials being applied as soluble salts, acetates, oxalates, or nitrates, which were then burnt off, giving a more coherent structure than was obtained by Cruickshank; the coated wires were afterwards heated by the passage of an electric current. It is evident, therefore, that by 1878, not only had the principles upon which the mantles of to-day are constructed been published, but the oxides of the rare earth metals had been recognised as incandescents.

In England the first practical attempts at incandescent lighting were in the early eighties, when the Lewis incandescent platinum mantle and the Clamond incandescent light were for the first time brought to the notice of the public. The Lewis mantle consisted of a cylinder or cone of fine platinum wire gauze fixed to the end of a Bunsen burner, the gas being supplied at ordinary pressure, whilst a current of air was forced at a considerable pressure up a central inner pipe, the injecting action of which also caused an additional supply of air through lateral supply pipes.

These mantles were never a great success. The necessity of using air under pressure was a serious drawback, but the most important objection to them was that the surface of the platinum was slowly corroded by the burning gas, and though the mantles yielded a very good light at first, the luminosity rapidly decreased to a very low point.

In the Clamond mantle a conical basket of threads of calcined magnesia was employed, being supported in a small platinum cage point downwards, and the flame was driven into it from an inverted burner above. These baskets were formed by moulding a paste of the hydrate and acetate of magnesia mixed with water, into threads which were then woven into basket form and ignited. In this system the gas and air were at first used under pressure, but in the later forms the basket was converted into a mantle by supporting it with its apex upwards, and an ordinary burner of the Bunsen type was used to heat it.

The above mentioned processes and researches really represent everything of importance that was done prior to Dr. Auer von Welsbach's great adaptation, for the various attempts to improve the Drummond light, the efforts of Bourbouze, Wiesnegg, Popp, and Sellon, to render the platinum mantle a success, and such publications as the much quoted patent of Stokes Williams have no real bearing on the subsequent introduction of the incandescent mantle.

Bunsen's laboratory at Heidelberg, which was the birthplace of the Bunsen burner, also supplied the idea of the mantle in the form which has revolutionised our systems of lighting, as it was here that Dr. Auer pursued those studies and researches on the rare metals and their salts, which afterwards stood him in such good stead.

The most generally credited story of his discovery is that whilst he was boiling a solution containing salts of some of the rare metals, the liquid boiled over and evaporated on the fibres at the ragged edge of a piece of asbestos card, which served to support the beaker and round which the flame was lapping. This endowed them with such luminosity as to attract Dr. Auer's attention, and he then devised a method of preparing a mantle of the oxides of these metals that should fit the Bunsen flame, and should be made up of sufficiently attenuated filaments to allow of the flame raising it to a sufficient degree of incandescence.

It is more likely, however, that as the high power of incandescing possessed by the oxides covered in his first patent of 1885 were traditions in the laboratory from the work of Bahr and Bunsen, the application of the principle underlying Talbot's and Frankenstein's experiments to the formation of a practicable mantle from these salts was in reality the first great initial step.

Be this as it may, it is impossible to give Dr. Auer von Welsbach too much credit for having brought into a practical form odds and ends of knowledge which up to this period had been almost useless, and which after another seven years of work and experience have resulted in one of the most remarkable successes of modern times.

In his 1885 patent Welsbach protected the idea of making a mantle by saturating the cotton fabric and then burning off, using mixtures of the salts which he gives as—

60 per cent. of	zirconia or oxide of zirconium.
20	,,	oxide of lanthanum.
20	,,	oxide of yttrium.

The oxide of yttrium may be dispensed with, the composition being then :—

50 per cent. of oxide of zirconium.
50 ,, ,, lanthanum.

Instead of using the oxide of yttrium, ytterite earth, and instead of the oxide of lanthanum, cerite earth containing no didymium and but little cerium, may be employed.

The mantles made under this patent served the purpose of accustoming the public to the idea, but commercially were a total failure, as the light they emitted hardly exceeded that which the Clamond basket has given, whilst they were far more fragile.

A number of tests made between 1886 and 1889, showed the light emitted to vary from three to six candles per cubic foot of gas consumed, the higher value being rarely reached; whilst on making mantles with the purer materials obtainable at the present time, according to the prescriptions given in the 1885 patent, the results obtained are :—

Composition of mantle.		Gas consumed.	Illuminating power.	Candles per c. ft.
	Per cent.	c. ft.	Candles.	
I.				
Zirconia ..	60			
Lanthana	20	5·4	12·9	2·4
Yttria	20			
II.				
Zirconia ..	50	5·5	9·4	1·7
Lanthana	50			

This shows that a good deal of the candle power of the earlier mantles was due to impurities present in the salts used, and also to the fact that the prescriptions used were continually being varied in hopes of improving the results, when obtainable thoria being used to replace the zirconia.

In 1886, Welsbach took out his second patent, which covered the use of thoria, either when used alone or mixed with zirconia, magnesia, yttria, erbia, neodidymia, lanthana, alumina, &c.

It is evident from the text of the foreign patents which correspond with the 1886 patent, that Welsbach had the impression that a pure thoria mantle had a very high power of emitting light, and that it was for this purpose that he patented it, whilst in point of fact, if the thoria be pure it emits practically no light at all, though later experience showed that it had properties which rendered it the most important of the oxides used in mantle manufacture, as its refractory nature gives a stability to the feeble structure that cannot be obtained by any other known body.

The thoria mantles made under the 1886 patent gave a service of 6 candles per cubic foot of gas consumed, but when now made with pure thoria, as specified in the patent, they give a duty of less than 1 candle per cubic foot of gas, whilst the other mixtures specified in the patents give results which hardly come within the range of practical utility.

	Gas consumed.	Light emitted.	Candles per c.ft.
I.			
Thoria (3 parts)......	4·4	9·0	2·0
Magnesia (2 ,,)......			
II.			
Thoria (1 part)........			
Zirconia (1 ,,)........	4·5	15·0	3·3
Yttria (1 ,,)........			
III.			
Thoria (30 per cent.)..			
Zirconia (30 ,,)..	4·7	12·2	2·5
Lanthana (40 ,,)..			
IV.			
Thoria (2 parts)......			
Magnesia (1 ,,)......	4·5	12·2	2·7
Lanthana (2 ,,)......			
V.			
Thoria (3 parts)......			
Magnesia (1 ,,)......	4·0	3·6	0·9
Lanthana (1 ,,)......			

The use of ceria, together with thoria, is mentioned in some of Welsbach's early foreign patents, but the exact date at which it was first realised that traces of ceria had the marvellous effect on the light emissivity of the thoria mantle that we find in the mantles of to-day, is not very clear. It is evident, however, that the advantage of the presence of small quantities of ceria was beginning to be realised by 1891, when Mr. W. Mackean, the chemist of the English Welsbach Company, read a very interesting paper before the Society of Chemical Industry, and pointed out that the use of ceria is by no means a disadvantage in small quantities, as it adds to the constancy of the illuminating power. He gave a table showing the influence of the presence of ceria, and also the influence upon the light which increasing quantities of ceria have. Thus, for instance, the ordinary percentage of ceria is 0·25, and this gives 25

candles for a consumption of 2·5 cubic feet of gas, or 10 candles per foot, but an increase in the percentage of ceria to 0·5 reduces this to 18 candles for 2·5 cubic feet. When 1 per cent. of ceria is added, a further reduction to 13·5 candles for the 2·5 cubic feet is found, but whilst the candle-power lost 43·2 per cent. in 1,000 hours with the 0·25 per cent. of ceria, it only lost 12·6 per cent. in one experiment, and 28 per cent. in another, with 1 per cent. of ceria present originally. He also, in the same paper, gave the composition for a mantle giving a yellowish light—lanthana 40 per cent., thoria 28 per cent., zirconia 30 per cent, and ceria 2 per cent.—showing that at this period the use of small quantities of ceria in mantles containing thoria was by no means unknown.

About this date mantles on the Continent began to show a marked improvement, and in 1891-1892 it was reported that Welsbach had produced new mantles yielding as much as 16 and 17 candles per cubic foot of gas consumed, and the same great improvement manifested itself in the English mantles. The cause of the great advance was made clear the following year by Mr. Moeller taking out the patent of 1893, in which he sought protection for thoria in combination with very small traces—not exceeding 1 or 2 per cent.—of the oxides of certain other rare metals, such as uranium, cerium, terbium, neodidymium, samarium, praxeodymium, yttrium, and lanthanum. The mantles of to-day nearly all consist of 99 per cent. of thoria and 1 per cent. of ceria, as, although several of the oxides mentioned in minute traces endow a non-luminous thoria mantle with the power of emitting light, yet ceria so far transcends the others in its capacity of not only exciting luminosity, but of keeping up the illuminating power over a long period, that as far as our present knowledge goes, it is needless to look beyond it.

From this brief description of the growth of Dr. Auer von Welsbach's great discovery, it is clear that our present mantles are the outcome of three distinct stages of invention.

1. The method of making the mantle and the use of the oxides of the rare earths.

2. Using thoria instead of zirconia as the basis of the mantle.

3. The effect of traces of other oxides on the light emissivity of thoria.

At the period when Welsbach commenced his classical piece of technology, the rare earths had been studied by but few, athough there were several illustrious chemists, first and foremost amongst whom stood Bunsen, who had made a special study of them, and knew how to prepare them in a condition of absolute purity. It was with the commercial and not the purely scientific side of the question that Dr. Auer had to deal, and the price of most of the constituents being almost prohibitive, the processes for purification, which necessitated a considerable loss of material, were not pushed to the point that can be reached at the present time with the enormously cheapened material at our disposal. The result was that the candle power of the earlier mantles was often more influenced by the impurities present in the materials used than by the actual composition of the mantle. This was undoubtedly the case with the nitrate of thorium used in the manufacture of the mantles made in the early nineties, for it was made from thorite and orangeite, and contained, besides thorium salts, cerium, lanthanum, yttrium, and neodidymium compounds in large traces.

The light given by these mantles having attracted attention, careful analyses were made, and it was found that the pure thoria gave practically no light, whilst directly the traces were added to it the high illuminating value of the mantle returned. Having found this, Dr. Welsbach applied for a German patent to protect mantles made with thoria containing 1 or 2 per cent. of ceria, but the patent was not granted.

Many experiments have been made in order to determine the effect of the percentage of ceria when added to thoria on the light emissivity of the mantle, and the results obtained vary in putting the highest light emissivity at from 0·9 to 3 per cent. of ceria, the reason of this discrepancy being due to a number of small causes acting together.

In order to get the maximum result, exact air adjustment is necessary, and traces of impurities must be very carefully eliminated. Under these conditions, the point of maximum emissivity is reached when the mixture is 99 per cent. thoria and 1 per cent. ceria. At this highest point, however, the mantle is peculiarly sensitive to air adjustment, and if this is not attended to in the most careful way, the results may vary between the limits indicated. Moreover it is necessary that the mantles should have been most carefully treated, first with dilute alkali, then with dilute acid, and should finally be thoroughly washed with distilled water and dried under conditions which preclude the

possibility of their being contaminated with dust.

If these conditions are observed it is found that, starting with a pure thoria mantle giving practically no light, the candle power rapidly rises as traces of ceria are added to it until the maximum is reached, when it again rapidly falls away with further increments of ceria, the colour of the light undergoing at the same time a very marked change, and acquiring a yellowish tint which with increasing quantities becomes gradually of a reddish character.

The narrow limit within which the highest light emissivity exists render a careful proportioning of the liquid for soaking the mantle of the greatest importance.

Experiments have also been made in order to try the effect which additions of various proportions of ceria have upon the life of useful light emission which the mantle possesses. These show that with a Welsbach mantle made under the ordinary conditions of impregnating the cotton fabric with a solution of the nitrates of thorium and cerium, the higher the initial illuminating value the more marked is the loss in light over a given space of time.

In the ordinary burning of a commercial Welsbach mantle it is generally found that the light increases for a certain period and that then a steady fall in illuminating power takes place, the initial period of gain in light emissivity being most probably due to the mantle shaping itself to the flame, whilst the gradual fall in power which takes place after that period has been completed is chiefly due to dust particles containing silica which are drawn in over the surface of the mantle by the chimney draught, and which fusing on the outside of the fine filaments form silicates having a lower power of light emissivity than the original oxides. This point will again be reverted to in the following lecture, where I shall have to show the important bearing which the form of the filaments composing the mantle has upon this power of keeping up its illuminating value.

In the Welsbach mantles made during the past few months the preliminary rise in illuminating power which used to take place during the first 100 to 120 hours has disappeared and the fall seems to start at once, this being probably due to the mantle being seasoned, *i.e.*, shaped and heated for some time before being sent out.

Since the facts which I have brought before you with regard to the thoria-ceria mantle have been fully ascertained, innumerable attempts have been made to evade the patent under which the Welsbach mantle is manufactured, but so far these attempts have not been of much profit to any but the legal profession and the experts. Indeed it may be stated that the only mantle which in England has had its position placed upon the same legal footing as the Welsbach mantle is the Sunlight mantle, in which advantage was taken of the power which oxides of chromium have of exciting luminosity when superimposed on a structure of alumina.

In some of the mantles which have been proposed small quantities of acidulous bodies are added, such as silicic acid, or the oxides of arsenic and antimony, with the view of converting a portion of the thoria into silicate, arseniate, &c., but in no case that I have tested does the alteration improve the mantle, either in life or light emissivity.

Another very popular method of making an alteration in the way of obtaining the mantle is first to produce a basis of thoria, and having got the fabric in thorium oxide, to coat it with a mixture of 99 per cent. thoria and 1 per cent. ceria. This modification of the process certainly seems to give an improvement in the mantle. In the "Voelker" mantle a basis of thoria is produced, which is then coated by dipping in a substance termed by the patent as "Voelkerite," a body made by fusing together a number of oxides in the electric furnace; the fused mass so obtained is then dissolved in the strongest nitric acid, and diluted with absolute alcohol to the necessary degree. A very good mantle, having great lasting power, is thus produced. It is claimed that the process of fusing the materials together in the electric furnace alters the composition in some unexplained way, but the true explanation is probably that all water of hydration is eliminated.

The "Daylight" mantle consists of a basis of thoria or thoria mixed with zirconia, which is then dipped in collodion containing a salt of cerium in solution, and on burning off the collodion the ceria is left in a finely divided condition on the surface of the thoria. There is no doubt that in this way a very high initial illuminating power is obtained, and I have seen mantles made on this principle which within a few hours of their ignition have given a total illuminating value of 100 candles with a service of 24 to 25 candles per cubic foot.

The "Crown" mantle, which is very largely adopted in Berlin, is a mantle of this description produced by making a mantle of pure thoria from a fabric of ramie saturated with the nitrate and then dipping the thoria basis in a mixture of 99 per cent. thoria and 1 per cent. ceria, the mantle so produced being of very considerable strength and retaining its power of light emissivity for a much longer period than the ordinary Welsbach mantle.

On the whole the Welsbach monopoly has been of considerable advantage, as in the ingenuity exercised in attempting to circumvent the patent many experiments have been tried and results obtained which would not have been discovered had the ordinary mixture and process been open to all users.

A careful observation of the Welsbach mantles in use shows that the light emitted by them is not by any means of a constant quality, and that you occasionally have batches of mantles which give a distinctly greener light than others. This variation in the colour of the light emitted is, however, very often found to be a function of the temperature to which the mantle is heated, and where you have the temperature and light emissivity highest you often find a greenish tint appearing which with a less well-arranged burner appears as a white light of a lower quality.

Many attempts have been made to compare the amount of light belonging to the different portions of the spectrum in the light emitted by the mantle, and in the following Table, published by Munsterberg, the proportion of rays of different colours emitted by the Welsbach incandescent mantle is compared with the number of the same rays in sunlight taken as unity and with other illuminants :—

Colour in spectrum.	Electricity.		Coal Gas.			Acetylene with air.	Sun
	Arc.	Incandescent.	Ordinary.	Welsbach.	Alone		
Red	2·09	1·48	4·07	0·37	1·83	1·03	1
Yellow .	1·00	1·00	1·00	0·90	1·02	1·02	1
Green...	0·99	0·62	0·47	4·30	0·76	0·71	1
Blue	0·87	0·91	1·27	0·74	1·94	1·46	1
Violet...	1·03	0·17	0·15	0·83	1·07	1·07	1

The value of the Table is, however, a good deal discounted by the conditions under which the experiments were made not being stated.

Miscellaneous.

INDIGO PLANTATION.

The *Times* correspondent in Simla reports that an important step has been taken to assist the indigo planters of Behar. It is well known that the cultivation of indigo has proved of late years unprofitable owing to the competition of artificial dye, so that there was imminent danger of the industry's collapsing altogether. In March last Mr. Christopher Rawson read a paper on the "Cultivation, Manufacture, and Uses of Indigo" before the Indian Section of the Society of Arts, in which the present state of the question was fully discussed (see *ante*, p. 413). Sir William Hudson, a leading planter in Behar, who took the chair at this meeting, applied in August for a loan from the Government for a scheme of sugar cultivation and manufacture, pointing out that land was available, and suggesting the growth of indigo and sugar-cane in alternate years or sugar-cane altogether. The Government was unable to accede to his wishes, but it has now sanctioned a committee of inquiry into the possibilities of establishing the sugar industry. Mr. O'Conor, the head of the Statistical Department, has been appointed president, and Mr. Hamilton, of Messrs. MacKinnon and MacKenzies, and Mr. Hancock, an agricultural chemist employed by the Planters' Association, are members of the committee, which has already met in Calcutta.

The Lieutenant-Governor of Bengal, in issuing the orders, notes that the indigo planters as a body have claims upon the Government. They have rendered valuable services in the past on many occasions of administrative stress, their disappearance would be in many ways a great administrative loss, and they have embarked a large amount of capital in the industry. The Lieutenant-Governor considers that any reasonable assistance which the Government can give in inquiries, either towards improved methods of indigo cultivation and manufacture or towards a substitute for it in the shape of more profitable crops, should certainly be given. Regarding the first of the above two suggestions, the Lieutenant-Governor doubts whether any advantage would result at this stage from an inquiry by the committee into the state of the indigo industry. In the present condition of the industry experiments regarding the best seed to be used and the most promising varieties of the plant, system of cultivating the soil, and processes for the extraction of the dye, must be patiently continued over a term of years—a task not fitted for a committee, the Indigo Planters' Association already doing all that is at present possible. That body has engaged at a large expense the services of two experts to conduct researches in India for the discovery of improved methods of cultivation and manufacture, and the Bengal Government has agreed to give to the Association, beginning with the next

financial year, £500 a year for three years for the appointment of a bacteriologist to investigate questions relating to the plant. Regarding the second point, there are grounds for believing that it may be profitable to the indigo planters of North Behar to take up the cultivation of the sugar-cane and the manufacture of sugar, either by growing cane as a rotation crop in alternate years and keeping up the growth and manufacture of indigo, or even by abandoning the latter industry altogether for the manufacture of sugar. It has been noticed that sugar cultivation in Bengal has hitherto been a failure, but the conditions are now more favourable owing to better methods of refining and to the cheaper transit due to the extension of railways. A great demand exists among the people for refined sugar, which was met by bounty-fed imports until the imposition of the sugar duties, it now being satisfied by imports from Mauritius. Cultivation in Behar has already been begun experimentally, and labour is cheap and abundant there, whereas it is dear and scarce in Mauritius.

*USE OF ALUMINIUM WIRE FOR ELECTRIC TRANSMISSION LINES.**

Up to the present time, discussions of the use of aluminium wire in line construction have considered only the relative prices of copper and aluminium wires, the conductivity, tensile strength, and other properties of the aluminium wire being considered merely as determining its relative price. During the past year the manufacturers of aluminium have demonstrated their ability to sell this wire at a price well below twice the price of copper per pound, and in consequence the new material has forced itself upon our notice and has demanded that we consider carefully all of its properties. Having recently been led to purchase a considerable amount of this wire by reason of the high price of copper and the low price of aluminium, the writers have made a careful study of the wire supplied, and now present the results obtained in hope that they may be of service to other engineers.

The line for which this wire was purchased is about 43 miles in length, and the country through which it runs varies in elevation from about 100 feet above the sea level to at least 2,000 feet, one half lying in almost a straight line through a country nearly level, while the remainder is over the mountains, through which the line runs almost straight, surmounting high hills and descending into deep gulches. In some cases the lengths of the pole were proportioned to decrease the vertical line deflection, but as an accurate preliminary survey was not available, much less grading of poles was possible than would have been desirable. This defect in pole-setting was largely remedied in the wire-stringing by drawing a number of spans at one time, so that at depressions and elevations there was very little up or down strain put on the wire when it was tied to the insulators. The standard pole used was of redwood, 30 feet in length, 7 inches square at the top, and tapering to 12 inches square at the butt, or about 12 inches at the ground line 5 feet above the butt. Each pole was gained for three cross-arms $20\frac{1}{2}$ inches between centres, the gains being cut $\frac{3}{4}$-inch deep, into which the cross arms were bolted by $\frac{5}{8}$-in. through bolts. The arms themselves were 4 in. by 4 in. Oregon pine bored for two pins each, the top and bottom arms being 3 feet in length, and the centre arm 4 feet. The wires were arranged in a hexagon, 24 inches on a side.

This system of construction presents some advantages for three-phase working at high voltages for long lines, especially where two sets of circuit are to be operated from the same bus bars. If both wires on each arm are at the same potential, the arrangement of each circuit is that of an equilateral triangle, each side being 41 inches, while the minimum distance for leakage between any two wires of different phases is 36 inches of cross-arm and 20 inches of pole. The length of the longest arm necessary is much less than that in any other system of construction; the pole head is symmetrically loaded, and for these reasons the pole construction is exceptionally stable under all stresses.

The line as erected carried only four wires arranged on the top and bottom cross-arms at the corners of a rectangle 24 inches on the short side, and 41 inches on the long side. This arrangement was adopted for the purpose of making temporary use of some two-phase machinery which was in place and underloaded, allowing certain new customers to be taken on quite a year in advance of the contemplated completion of a three-phase plant for which the pole line was really designed. It was at first feared that this arrangement of the wires would result in inductive disturbances between the phases, as the wires were at the diagonally opposite corners of a rectangle, instead of the corners of a square, as is necessary for complete absence of mutual induction, but the anticipated trouble was not found. Careful measurements were made with one phase short-circuited and the other carrying about 20 amperes with a periodicity of 60 cycles per second, both with a Weston 75-volt voltmeter and a Rowland electro-dynamometer, with the result that no deflection was observable on the voltmeter, while the current read on the electro-dynamometer amounted to only about 001 ampere, the resistance of the dynamometer being 25 ohms. Only one further matter of installation needs attention, which is the presence on the tops of the poles of a barbed wire stapled to the wood of the pole and grounded at every fourth pole by a galvanised iron wire leading down along the pole and soldered to an iron plate 18 inches square and $\frac{1}{8}$ inch thick, set in the

* Abstract of a paper read before the American Institute of Electric Engineers, by F. A. C. Perrine and F. G. Bawn. From the *Engineering Times* of New York.

pole hole immediately under the foot of the pole itself. This wire was intended as a lightning guard, and it has apparently done very effective service in discharging the line in all weather.

The mechanical properties of the wire present some well marked characteristics. In the first place, the number of twists necessary for fracture varies considerably, although the ductility test of wrapping six times around its own diameter, unwrapping and wrapping again is well sustained. This irregularity in the twisting test is generally a mark of impurity in the wire, but we know so little as yet of the exact characteristics of aluminium, and the twisting test is in general so unreliable that it is unsafe to base any exact statement on this one test, particularly as the wire after erection proved reliable. In carefully performing the test for tensile strength, no exact point could be assigned for the elastic limit, as the metal seemed to take a permanent set almost from the first, but at a stress of from 14,500 lbs. to 17,000 lbs. per sq. in., there is a marked increase in the permanent set, which indicates that the safe working load lies somewhere in this region. In this the characteristics of the aluminium do not differ materially from those of copper or other similar metals, and while this is a disadvantage it is not a singularity. The fact that the wire will permanently elongate if seriously strained, makes it necessary to use the utmost care in the erection of lines, and, also, the known high coefficient of expansion with temperature changes, taken in conjunction with this property, renders care in line stringing especially important.

For the purpose of ascertaining exactly what were the changes with temperature that might be anticipated, the Pittsburg Reduction Co. undertook a series of experiments with 200 feet spans of wire at temperatures varying between 6° F. and 55° F., and at the same time the authors carried on a similar series of experiments on a 150 feet span at the Leland Stanford, Jr., University in which the temperatures varied between 20° F. and 80° F. From the results of these experiments a co-efficient of expansion with temperature was obtained, which was used in calculating sets of tables for the instruction of the line foreman, which gave the tensions and deflections at the different temperatures encountered. These tables were calculated by use of the ordinary approximate formula for the tensions and deflections of a suspended wire, and the method used for obtaining the coefficient of temperature expansion removes the usual objection to the formulæ that they do not take into account the elasticity of the wire itself, which produces serious errors if an attempt be made to use the true coefficient of linear expansion with changes of temperature. In fact, the coefficient of linear expansion obtained from these experiments is less than one-half the value of the true coefficient of linear temperature expansion, but its use is justified by the fact that the tables as calculated have been frequently verified experimentally, both at the testing stations and in the field while the line was being strung. As a result of these tests the Pittsburg Reduction Co. has issued a table of deflection tensions and temperatures.

One of the most serious problems in connecnection with the use of aluminium is in the choice of a proper joint. This metal is so highly electropositive that it is unsafe to expose it to the elements in contact with any other material, as electrolytic corrosion is almost sure to follow such construction. Many of the failures which have been reported of this metal have been due to a neglect of this fact: as notably in the case of the plates on the yacht "Defender," where the plates have been corroded at the contact with the bronze rivets used in fastening them to the frame. Whenever this metal is soldered or used in contact with any other metal, the joint should be thoroughly waterproofed to prevent such action. After discussing many joints, it was finally determined to abandon any attempt to solder or clamp the wire in any manner, and the joints were made by slipping the ends of the wire into an oval aluminium tube about 9 inches long, which was then twisted with a pair of clamps similar to those employed in twisting the McIntire connector. After twisting the tube a turn was taken by hand of the loose ends and the wire cut off close. The joint produced proved practically equal to the original wire in both tensile strength and electrical conductivity,

This wire was erected during the winter of 1898-99, which was an unusually open winter over the whole State of California, allowing practically continuous construction work, though the temperature varied all the way from 30° F. to 80° F. at times when the wire was being strung. After it was finally erected it remained about three months on the poles before the machinery was delivered and put in place. During the first month of that time three breaks occurred which were all apparently due to flaws in the material, but after these breaks were repaired the line wire gave absolutely no trouble whatever, though various accidents occurred to other parts of the construction. Many insulators were shot at and broken, bale wire and bale rope was thrown over the line, a twig short-circuited one phase and fell down burned, a large bird was killed by contact with the wires, and finally several porcelain insulators with porcelain pins were broken off and hung suspended by the wire. In January and February of the present year this whole line was taken down to give place to a much heavier one of the same material, an opportunity for such a total change having been found after the total destruction of the power-house by fire last November.

During the past two years other lines of aluminium wire have been erected on the Pacific Coast, all but one of which have given a considerable amount of trouble from causes that are not entirely apparent. One line in Nevada county, erected at about the same time as that we have been describing, and for which the wire was practically the same lot, has given no trouble whatever. The power transmission lines of aluminium wire about Seattle have broken a few times, but have not given serious trouble. The

breaks in this line, so far as the writers have been informed, seem to have been due to not allowing enough sag at the higher temperatures, and a consequent overstraining of the wire in cold weather. The most serious difficulties have been encountered by the telephone company in Washington and Oregon and by the Yuba Power Company. In all of these cases it seemed almost impossible to keep the wires on the poles in certain sections, and in these sections the lines have been finally taken down and replaced by other wire of either copper or aluminium. The writers have examined many breaks from these lines, and would judge from the appearance of the fracture, that the causes, whatever they might have been, were similar. In these breaks there are many small flaws, but by far the greatest majority are clear, sharp fractures, with but a slight reduction of area, and that entirely on one side, a break very characteristic of improperly mixed and brittle alloys. Partially from the appearance of the fracture and partially from the facts that the breaks occur only in certain sections of the line, the writers are of the opinion that this trouble is due to the presence of impurities in the material. This view is strengthened by the fact that when measurements were made on the line of the Yuba Power Co., the resistance of the whole line was found to be 10 per cent. greater than it should have been if it were made of the quality of material described in the earlier part of this paper. Furthermore, in one-half of this line there were no breaks at all due to defects in the wire itself.

As a general conclusion, it is the opinion of the writers that aluminium can be safely used in place of copper where the proper precautions are taken in inspecting the wire before it is erected, and in erecting it with due consideration of the peculiar properties of low and indefinite elastic limit, high coefficient of temperature expansion and active electrolytic power. As indicating our faith in this opinion, it may be noted that for the new line soon to be erected an aluminium strand $\frac{3}{4}$ inch in diameter has been ordered. This strand will be spliced with aluminium sleeves, and in the whole construction about one million pounds of aluminium will be employed.

UTILISATION OF THE WASTE GASES FROM BLAST FURNACES IN GERMANY.

In connection with the metallurgical industry in Germany a very important innovation is the utilising of the waste gases of blast furnaces for working gas-engines. From this innovation it is hoped that whole districts may be benefited, as is the case when an unexpected water-power is developed. The gases could hitherto only be used on a moderate scale; they were utilised for indirectly warming the blast to 850° C., and partially for burning under the boilers. It is due to the progress of science, and its adaptation to practical technics, that the waste gases can now be made serviceable in their entire heating capacity by rational burning in gas-engines. What this innovation means economically is seen by a theoretic calculation, according to which this use yields a profit of 5s. per ton of pig-iron production, and which means for Germany alone a gain of £2,190,000 on her entire raw iron production. Her Majesty's Consul-General at Frankfort-on-Maine states that gas machines for utilising the gases were introduced into Germany about two years ago. It is the "Hörder Hütter Verein" to which credit is due for having used the first rationally built gas-engine for this purpose on the Deutz system. Almost simultaneously with the Hörder Verein, the Friedenshütte, in Upper Silesia, made use of such gas engines. Since then similar or smaller plants have been erected in numerous German and other foreign establishments. From all quarters good results are reported, which lead one to believe that the great development of the gas-machine industry has by no means reached its climax. Blast-furnace gas-engines of large dimensions have been erected already at Hoerde, Friedenshütte, Oberhausen, Düdelingen, Ilseder Hütte, Amnetz Friedo, Völkingen, Donnersmarckhütte, Differdingen, in the Rhenish steel works at Ruhrort, at Seraing, &c. The manager of the Donnersmarckhütte, reporting at a trade meeting regarding the results obtained at that place, stated that the blast-furnace gas-engine, which had been in use then for five months, was working at 100 horse-power, with 130 revolutions. The gas, before entering the gas-engine, passes a so-called scrubber and sawdust cleanser, whereby daily about three pounds of dust is separated in the form of a thin paste. Regarding the action of the regulator, it was observed that the gas-engine was quite as safely controlled by the regulator as a good steam-engine. Within two periods of work, differences in the action of the machine were indeed observable. This, however, need not come into consideration for plants working with single current. The gas-engine only consumed about two pounds of cylinder oil and under four pounds of machine oil (both of good quality) daily, whereas the water used daily was at the utmost 100 cubic mètres. It is stated that the Donnersmarck establishment in consequence of these good results will shortly erect a further gas dynamo of 600 horse-power. The managers calculate that if the quantity of gas which hitherto when burning under boilers produced 1,000 horse-power in round figures, be used for burning in gas-power machines, it will increase the production by 2,700 horse-power, and that inasmuch as the proportion of the coal price of gas is equal to 1 horse-power amounts to 100 marks (£5), by introducing gas-power engines a saving of 270,000 marks (£13,500) may be effected. The Kombach establishment in Lorraine (with seven big blast furnaces and an ingot ironwork) is shortly to erect two gas-engines, with four cylinders, each of together 1,200 horse-power. Without electricity the advantage of these gas-engines could only be partially utilised. This is seen in the case of hoisting machines and

pumping engines in mines, and the numerous motors of the rolling mills which cannot be worked direct by gas-power engines. Here, the electric transmission by power must step in as an auxiliary; the advantage of this is incalculable, notwithstanding the loss of about 20 per cent. in energy. Especially for winding engines with their unusually large consumption of steam, the blast-furnace gas-engines with electric transmission of force will be of the greatest importance; no less so for pumping engines with their very long steam conduits. If the last and most modern steam-engine of 12 atmospheric pressures, superheater, economiser, and short conduits with the top gas machines, it must be allowed that the latter under all circumstances with the same consumption of gas produce twice as much as a steam-engine, if the steam is produced by gas burned under the boilers. Here again, according to Sir Charles Oppenheimer, is a convincing argument for the great benefit derived for production and technics by scientific work.

In describing the progress made in this direction in Germany, Sir Charles Oppenheimer does not refer to the fact that it is the Cockerill Company of Seraing, Belgium, who, with the co-operation of Mr. E. Delamare-Deboutteville, were the first to successfully solve the problem of the direct utilisation of blast-furnace gases as a source of energy. Since 1895 a gas-engine of this kind has been working at the Cockerill works, and the 600 horse-power single cylinder gas-engine exhibited at the Paris Exhibition by the Cockerill Company has created quite a revolution in the metallurgical industry. Details of this engine were furnished in papers read by Mr. A. Greiner before the Iron and Steel Institute in May, 1898, and in May, 1900.

THE LIQUOR TRAFFIC IN RUSSIA.

The Russian Government has for many years been labouring and discussing means to diminish the almost universal use of liquor among the labouring classes. One of the first steps towards preventing the unrestricted sale of liquor was to confine its sale to places where food was required to be furnished with each order for liquor in order to prevent persons from taking one glass of drink after another without food. Several penalties were also provided for selling on credit, for receiving goods in pawn for drink, or for bartering spirits for produce, or future labour, &c. The receiving of stolen property entailed the loss of licence, and provision was made for closing public houses that evaded or violated the laws. The Government established a number of shops in various parts of cities for the sale of vodki, brandy, and other spirits in corked bottles. These spirits are not permitted to be consumed on the premises, but says the United States Consul-General at St. Petersburg, thirsty customers purchase small bottles and step outside of the door, draw the cork, drink the contents and return the empty bottle for which they receive a few kopecks. The number of these shops is regulated by the population. It was first proposed in 1885 that the Government should assume control of the sale of liquor, but the revenue from the sale of liquor amounted at that time to about £35,000,000 per annum, and it was argued that the Government monopoly would reduce this so materially as to affect the revenues. Hence it was delayed until the famine of 1891, and the lamentable state of things it revealed hastened the reform, since which time the new system has been organised and introduced in half of the empire, including 35 provinces, covering 1,230,000 square miles, with a population of 61,000,000. Under the present system the Government dictates the quantity and quality of spirits manufactured, purchases a very large per-centage of the output, and permits the sale of the surplus, under proper regulations, for manufacturing purposes, with the intention of furnishing the consumer with pure spirits, thus mitigating and preventing such abuses as are directly attributable to the excessive use of bad liquor, and improving the morality and prosperity of the masses. The Russian peasant classes drink only vodki, which is distilled from rye, and sold at the average price of 5s. 10d. per gallon, whether in quantities of one or 1,000 gallons. The Government requires that the wine of vodki and brandy shall be 40 degrees, and that of spirits of wine 90 to 95 degrees. The official report for 1898, just issued, states that the amount of capital employed during that year was £29,600,000. There were 1,381 brandy distilleries, 252 spirit distilleries, and 27,120 places where distilled liquors were sold. Besides this, fermented liquor was sold at 14,699 houses. The sales amounted to 84,003,752 gallons, the gross receipts being £23,500,000, the expenses £7,300,000, and the excise duty £12,800,000. The net income to the Government from sales was £3,347,000. In districts where the sale of liquor is controlled by the Government, temperance societies have been organised with Prince Oldenburg, a distinguished philanthropist, of St. Petersburg, as president. These have opened reading-rooms, with libraries and restaurants near public gardens and squares, where large numbers of working people congregate, and they sell cheap and good food with such temperance drinks as tea, milk, and "kvass." One of these societies has constructed two floating restaurants, one of which will seat 600 people and the other 300. These boats are towed to points on the Neva where workmen are employed or congregate. An open theatre has been established on Petrovsky Island, where a good class of plays is given at a nominal price. Some of the public parks are also supplied with apparatus to encourage open-air sports. The Government is encouraging these societies, aud has rendered them financial aid. It is expected that by the end of 1902 every one of the provinces of Russia, including Siberia, will have been included in the sphere of activity of these societies.

Correspondence.

BRITISH CANALS.

If the question of canals in India presents a problem of importance, as undoubtedly is the case, it seems to the writer that the subject should not be without interest to ourselves. We have old canals running in various parts of our islands at present nearly, if not quite, disused, with locks and falls. Each fall might be utilised for the generation of electricity, by which a source of working power might be easily brought into use at a low rate. By the use of appropriate means the side-wash of the screws of barges could be eliminated, and damage to banks be avoided. Our canals should be looked after and not allowed to slide into mere waste as they now unfortunately do. Every foot of navigable inland water should be turned to account, and every foot of fall should render a good account of itself as a source of power either for electric traction or light or as a source of power in some way. All this could be carried into effect without damage to scenery or anything else, whilst material benefit to the country could not fail to accrue. We should utilise our waters and do all we can to make the best use of what our predecessors erected at no small cost. By electricity generated by the natural falls of streams, we might create vast amounts of useful power at a very small cost. That power would always attract and commend the attention of those concerned. It is by utilisation of waste power that we can do great things at small outlay. Use the winds as much as possible, but winds are too variable for us to depend on them for the regular supply of power. Water, wind, and electricity, if only properly used in proper conjunction on our disused canals, might do great things for the benefit of inland navigation and generation of useful power. Every foot of fall in a stream or canal offers the engineer a source of power: it is for him to utilise it to the best of his knowledge. With wind power and waterfalls as sources of electricity we have cheap energy at hand. Why do we not make use of all such means? If properly handled we might do much to bring into extensive and every-day use what is not now appreciated—the benefits of waste water. Again, were the canals revivified—if the expression may be allowed—how much pleasure might be afforded to our inland dwellers by water excursions thereon? Our inland scenery can hardly be appreciated as an express train rattles us across country. Inland navigation would give much pleasant change of air and scene and afford instruction, health, and exhilarating pastime for our hard-worked town dwellers at small outlay. It should be an object to induce people to explore the beauties of their own country and spend their money at home, rather than to rush abroad and scatter their cash amongst foreigners. Hotel accommodation would very soon be forthcoming. Demand in this direction would very soon create supply where needed.

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General Notes.

MINING AND SMELTING INDUSTRIES OF SPAIN.—It has long been known that Spain is rich in mineral ore. Want of enterprise and capital have hindered the development of these hidden treasures, but there are signs which indicate that this stagnation will be thrown off. Spain exports each year a great deal of iron ore. In 1876, the kingdom exported 359 tons of copper; in 1890, it had increased to 46,000 tons, and in 1899 to 1,000,000 tons. From 1890 to 1899, Spain's exports of lead increased from 140,000 tons to 172,113 tons. During this time the export of ores of every description increased tenfold. Bilbao is the seat of the Spanish iron and smelting works. Ores are also found in Seville, Cordoba, Almoria, Murcia, and throughout the Pyrenees. Vast fields of coal, together with unused water-power abound in Asturia, North Castille, and Andalusia. In 1899, Spain exported 8,073 tons of coal. The total value of the products of the Spanish iron and smelting works for 1898 amounted to £12,313,000, an increase of £2,070,000 over 1897.

GERMAN ELECTRICAL WORKS.—According to a recent German report, electrical works in Germany show a regular and constant increase. On March 1st last there were in operation 652 electrical works, against 489 the previous year. One hundred and twenty-two works were in course of construction. Twenty-seven of all the works were completed before 1890; all the others were constructed within the last ten years. The number of places with electric light exceeds that of places illuminated by gas—900 against 850. The largest electrical plant is at Rheinfelden, with 12,360 kilowatts. Then follows one at Berlin, 9,230 kilowatts; one at Hamburg, 7,290 kilowatts; one at Munich, 6,110 kilowatts; two others at Berlin of 5,452 and 5,312 kilowatts respectively; one at Strassburg, 4,955 kilowatts; two others at Berlin of 4,676 and 4,655 kilowatts respectively; one at Chorzon, 4,310 kilowatts; one at Frankfort, 4,152 kilowatts; one at Dresden, 3,580 kilowatts; one at Stuttgart, 3,208 kilowatts; and another at Hamburg, 3,150 kilowatts. All the electrical works supplied last year 2,623,893 incandescent lamps, 50,070 arc lamps, 106,368 horse-power for electromotors, &c.

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CANTOR LECTURES.

THE INCANDESCENT GAS MANTLE AND ITS USES.

By Vivian B. Lewes.

Professor of Chemistry, Royal Naval College, Greenwich.

Lecture II.—Delivered May 14th, 1900.

In the last lecture an attempt was made to trace the inception and growth of the incandescent mantle as it exists to-day, and it will be well now to tabulate the oxides which have been used in the manufacture of incandescent mantles, and see the amount of light emitted by each under the conditions existing in the mantles.

Light Emitted by Various Oxides.

Oxide.	Pure.	Commercial.
Metals.		
Zirconia	1·5	3·1
Thoria	0·5	6·0
Earth Metals.		
Cerite Earths—		
Ceria	0·4	0·9
Lanthana	—	6·0
Yttrite Earths—		
Yttria	—	5·2
Erbia	0·6	1 7
Common Earths—		
Chromium Oxide	0·4	0·4
Alumina	0·6	0·6
Alkaline Earth Metals.		
Baryta	3·3	3·3
Strontia	5·2	5·5
Magnesia	5·0	5·0

In utilising these oxides for the manufacture of mantles it is evident that there are many points besides the power of emitting light which must be taken into consideration.

Some salts shrink so much during the conversion by burning into oxides that a mantle of very considerable initial size would have to be taken in order to get a skeleton of oxide of sufficient dimensions to fit the flame; other oxides which promise well as far as their shrinkage during formation goes, are found to slowly volatilise under the influence of the Bunsen flame, so that in the zone of most intense heating the thread of oxide gets thinner and thinner, and gradually disappears; other oxides, again, are brought too near to their point of fusion, and soften to such an extent that the mantle shrinks in where most heated and gets inside the zone of greatest heat, giving rise to a considerable loss of light, whilst other oxides, like yttria, give so distinctly coloured a light as to be objectionable. Careful testing both as regards duration and strength leads one to the conclusion that of the oxides given thoria, zirconia, and alumina alone can be used for forming the structure of the mantle, but alumina has the drawback that the mantle is very hard and not easily shaped in the blow-pipe, shrinks in the zone of greatest heat and slowly volatilises, whilst zirconia mantles are liable to considerable and rapid shrinkage, so that thoria practically stands alone as the ideal basis for a mantle, as it is easily shaped in the blow-pipe flame, gives a comparatively small shrinkage when the fabric containing the nitrate is being converted into oxide, and when formed the mantle resists the action of temperature for a longer period than any other known oxide.

Perphaps the most important property is the enormous increase which takes place when thorium nitrate is converted into oxide, as if a comparatively small mass of nitrate be heated on platinum foil, it swells up in much the same way that the sulphocyanide of mercury constituting the old "Pharoah's serpent" does, and the small bulk of nitrate becomes an enormously larger mass of thorium oxide, so that although in the mantles as now used there is 1 per cent. of ceria by weight, the proportion by volume is less than 0·1 per cent.

Having got the basis of thoria it is seen that in its pure condition it only emits about half a candle of light per cubic foot of gas consumed, but the difference between the lighting power of the pure thoria and the commercial at once indicates how sensitive it is to the exciting influence of small traces of impurities. When admixed with 1 to 2 per cent. of ceria it acquires a power of light emissivity combined with duration which is unequalled by any other known mixture of the available oxides.

Many attempts have been made to explain in a satisfactory manner the marvellous power which the minute trace of ceria has of awakening to life the light-giving power of the mantle. In order that the mantle may emit its full measure of luminosity it has to be heated in the extreme fringe of the outer zone of the Bunsen flame, and here it is that the combinations take place between the products of incomplete combustion and the oxygen of the air. Such theories as attribute the power which the mantle has of emitting light to some special action that the ceria has in converting heat rays into light rays, which was the one put forward by Dr. Drossbach, are at the present time discarded in favour of the theory that both the air and gas are taking part in the actions which induce the luminosity.

Drs. Killing and Moschelles are of opinion that the ceria particles on the surface of the mantle are heated to a higher temperature than is the surrounding material owing to cerium being a metal which forms two oxides, the lower, cerous oxide (Ce_2O_3), and the higher, ceric oxide (CeO_2), and that at a high temperature under the reducing action of the hydrogen and carbon monoxide, the ceric oxide becomes reduced to cerous oxide with the liberation of oxygen, which combining on the surface of the ceria with the combustible gases in the burner, induces a far higher temperature in the ceria than exists in the thoria, and they suppose that the cerous oxide so formed undergoes oxidation to the higher compound by the action of the excess of air present.

It is hard, however, to accept this theory in view of the extremely narrow range over which ceria acts as a useful excitant of the thoria basis, as one would expect that if the theory were a true one, the more ceria that was present the more particles would be heated to high incandescence, and increase in the quantity of ceria would increase rather than reduce the power of light emissivity.

The second theory and the one now most generally accepted is that propounded by Dr. Bunte, who ascribes the high illuminating effect produced by the trace of ceria as being due to a catalytic action of the same character as causes a piece of platinum foil, which has been heated in order to cleanse its surface, to become red hot when a current of mixed coal gas and air is allowed to impinge upon it, the action here being due to the power which platinum possesses of compressing both coal-gas and air upon its surface, and rendering them so chemically active that they combine on the surface of the metal, and emit sufficient heat to raise the mass to a bright red.

Dr. Bunte made a number of experiments as to the influence of thoria and ceria in bringing about the combination of hydrogen and oxygen, and he found that at 1,200° Fahr. (649° C.), a mixture of hydrogen and oxygen, in the ratio of 2 to 1, when passed through a heated porcelain tube, combined to form water, and that the presence of thoria in the tube had no effect in lowering the temperature at which this action took place. When, however, the oxygen and hydrogen were passed through a tube containing ceria, the action commenced at 600° Fahr. (315·5° C.); and he concludes that this catalytic action, localising a high temperature in the small particles of ceria spread over the surface of the large mass of inert thoria, is the cause of the high light emissivity.

Had Drossbach been right in ascribing the light of the mantle to any peculiar light emissivity on the part of the oxides, proof of this ought easily to have been obtained by the way in which rare oxides and mixtures behave when heated out of contact with air. Dr. Bunte found that in trying this experiment there was a very small difference in the noticeable light radiation from bodies of such widely different light emissivity as carbon, magnesia, thoria, or the mixtures used in the Welsbach mantle.

In order to prove this, Bunte took a thick-walled tube of retort carbon, the walls of the middle portion of which were reduced to a thickness of 0·059 inch for a length of about four inches, and on passing a strong current of electricity through the retort carbon cylinder, the resistance of the thin walled portion caused it to be heated up to whiteness, the temperature attained being estimated by him at over 3,630° F. (1,999° C.). The tube was prevented from burning away at this highly heated point by being coated with magnesia, over which an outer wrapper of asbestos paper was pressed, and in the interior of this tube small square prisms of magnesia were placed, coated with the substances to be examined, each prism being compared side by side in the hottest portion of the tube. The conditions existing could be observed through a small sight-hole at the end of the carbon tube.

By using double prisms, one of which was coated with the substance to be tested and the other with a standard substance of known composition, it was found that practically little or no difference existed between the various materials tested. This point was also con-

firmed by some very interesting experiments made by Mr. Swinton, in which he enclosed various mantle materials in a vacuum tube and submitted them to cathode rays, by which a very high temperature can be obtained, capable of raising finely divided carbon to incandescence and fusing platinum into glass. Using mantles made up of small squares of ceria and thoria alone and mixed in varying proportions, he found that, although the mixture of 99 per cent. thoria and 1 per cent. ceria in a vacuum heated up to incandescence more rapidly than pure thoria alone, and on stopping the discharge cooled down more rapidly, its incandescence was only very slightly greater than that of the thoria alone.

Both these experiments clearly show that the idea of the Welsbach mantle having any peculiar power of converting heat rays into light must be discarded, otherwise the same differences would have been noted when the materials were heated out of contact with air as when heated in the presence of air.

There are many facts which tend to support the theory that the light is due to the particles of the oxide of ceria being heated to a higher temperature than that of the flame. My own researches on the cause of the luminosity of flame, point to the splitting up of the molecule of acetylene with the liberation of the endothermic heat contained in it as endowing the carbon particles with a temperature far above that which exists in the flame, so that the temperature of incandescence in the hydrocarbon flame is due to the heat of the combustion, plus the local endothermic heat of the decomposition, and in the same way in the mantle it is probably the heat of the flame which heats the whole of the mantle, plus the locally intensified points of excessively high temperature due to the catalytic action of the ceria upon the mixture of oxygen, carbon monoxide, and hydrogen, that gives the intense power of emissivity that the mantle possesses, the theory being made more probable by the fact that other substances known to have catalytic powers, when used in sufficiently small traces, give similar although not such marked results.

An objection to this theory may be raised from the fact that the amount of ceria is so minute that it does not seem possible that it should play any important part in the light-giving power of the mantle. Dr. Bunte, however, overcomes this by pointing out that in an ordinary gas flame the luminosity is due to the liberated carbon particles being heated to an intense degree. This carbon is obtained chiefly from the decomposition of unsaturated hydrocarbons, which together only form about 5 per cent. of the volume of the gas. Supposing that all the carbon of the unsaturated hydrocarbons be liberated and heated to incandescence, it may be calculated that about 54 milligrams of carbon are separated from a litre of coal-gas or 23·6 grains from one cubic foot. Thus 4 per cent. of ethylene and 1 per cent. of benzene give per litre of gas 60 cc. of carbon vapour from the benzene and 40 cc. from the ethylene, in all 100 cc., which is equal to about 54 milligrams of carbon. The volume of the luminous portion of a flame having a consumption of 5·297 cubic feet per hour, and an illuminating power of 17·5 candles, is about 2 cc. at 32° Fahr. (0° C.). It therefore contains $2 \times 54 \div 1{,}000$ mg or 0·1 mg (0·0015 grain) of incandescent carbon, and this small quantity of 0·0015 grain of incandescent carbon is sufficient to yield a light of 17·5 candles. In a Welsbach mantle the amount of ceria is about 4 mg, 0·06 grain, or forty times the quantity of the incandescent carbon in an ordinary flame, and therefore this is quite sufficient to explain why the Welsbach mantle gives a light of 80 candles, when the argand burner only affords 16·0 candles.

The point that always seems a difficulty to me in this theory is that, if it be the true one, the only explanation of 1 per cent. of ceria being the amount that gives the maximum light emissivity, would be that in the outer envelope of the flame there was just sufficient unburnt combustible gas for this amount to act upon by its catalytic power, and that an increase of the combustible gas at this point should enable one to increase the amount of ceria present, but so far I know of no confirmation of this. Nor does the minute trace of ceria have the same exciting effect upon a zirconia or alumina basis. We have probably much more to learn as to the true action of the trace of ceria in exciting the light emissivity of the thoria mantle, and it must be borne in mind that thorium itself has some strange, and, at present, unexplained action towards light, which enables it to act in the same way as radium towards a sensitised plate in the dark.

The actions which lead to the emission of light in the "Sunlight" mantle are of the same character as those taking place in the thoria-ceria mantle. The basis is alumina, which itself has no power of emitting light, but is endowed with that power by the addition of chromic acid, which when itself made

into a mantle is also void of any practical illuminating emissivity. Chromium, like cerium, forms two oxides, so that the theory of Killing and Moschelles would also apply to its light-emitting power.

The light given by such a mantle is entirely dependent upon the proportion of the oxides of chromium present, and whilst with a small percentage only and using a dilute solution of alumina salt it is possible to obtain a nearly white light, increase in the strength of solution and percentages of chromium oxides gives a reddish yellow light.

It is impossible, however, in practice to use a solution for saturating the cottons sufficiently dilute to give anything approaching a white light, as if this is done, although the mantle will give a good light of about 14 to 15 candles per cubic foot of gas, the mantle shrinks so rapidly that in a comparatively short space of time it gets out of the zone of greatest intensity and only emits a very feeble light, whilst if the percentage of chromium is increased the light emitted is not so high, rarely exceeding 11 candles per cubic foot of gas, but the mantle lasts fairly well for three or four hundred hours.

Analyses of the "Pink Sunlight Mantles" show them to be composed of—

Alumina	86·88
Chromium Oxides	8·68
Zirconia	4·44
	100·00

The zirconia being added to give greater strength to the mantle.

In these mantles the alumina, if used alone, would volatilise slowly at the heat of the Bunsen flame, so that in the zone of greatest intensity the threads rapidly would become thinner and thinner until finally they would disappear, this point being arrived at before the mantle has been in use 100 hours; the alumina, moreover, is near its fusion point, and is softened and rapidly shrinks. The oxides of chromium also slowly evaporate when continuously heated, so that the materials do not give much promise in making a good mantle, but when mixed together, or when the alumina mantle is sprayed with a dilute chromium solution, a far more stable compound is formed, of a pink colour, and it probably dissociates slowly when heated for a long period, yielding a continuous supply of traces of oxides of chromium, which are the real source of the luminosity, and gradually burn off.

If, instead of an alumina basis, a pure thoria mantle be sprayed with the chromium solution, it becomes endowed with a certain degree of luminosity, but this rapidly falls away, there being nothing to prevent the volatilisation of the chromium oxides.

The property which the chromium has of increasing the illuminating power, and prolonging the life of such basic bodies as it can unite with, is well shown in the case of the Fahnehjelm comb, which was originally made of magnesia rods, and lasted barely 100 hours, so rapidly did the magnesia volatilise; when, however, the idea arose of dipping the magnesia rods into a solution of chromic acid, it was found that not only was the power of emitting light nearly doubled, but that the life of the comb was increased threefold.

Many attempts have been made to improve upon or alter the composition of the 99 per cent. thoria and 1 per cent. ceria mantle by mixing such bodies as zirconia with the thoria, but it is nearly always found that any attempts in this direction tend to make the mantle far more susceptible to shrinkage, whilst if the foreign body so introduced is present in sufficient quantity to give any practical economy on the thoria saved, the light is at once affected.

Dr. Ernst Hintz, of Wiesbaden, whose researches on the composition of incandescent mantles and the influence of various factors on their light-emitting power are, perhaps, the most complete ever made, found that quantities of neo-didymia, lanthana, and yttria up to 2 per cent. have no influence on the light emitted by a mantle, the remainder of which consists of thoria and ceria in the ratio of 99 to 1, that 2 per cent. of zirconia just begins to affect the mantle, and that larger quantities of any of these bodies have a detrimental effect upon the light. His experiments and researches are of especial interest, as they show fairly conclusively the inception of the present mantle from the compositions mentioned in the 1886 or thoria patent.

The two minerals available for the preparation of thorium salts at the time of this patent, and, indeed, up to about 1892, were thorite and orangite. These are found in Norway, and are crude hydrated silicates of thorium containing from 50 to 72 per cent. of thoria together with traces of several other oxides of the rare metals, including ceria. From these the liquid for impregnating the mantles was made without any special precautions being taken to eliminate the traces of the other rare earths, the mantles made from this fluid being looked upon as consisting of pure thoria, whilst Dr.

Hintz and others found that by employing the same methods of separation as were used for the manufacture the composition of the oxides made from the fluids obtained from these minerals was—

	Thorite.		Orangite.
Thoria	96·606	..	92·416
Ceria	0·994	..	3·162
Neodidymia and Lanthana	1·205	..	3·227
Yttria	1·195	..	1·195

compositions which agree very closely with analyses made of mantles sold in 1891-92, and which yielded an illuminating power of the same value as mantles made from liquids of this composition.

Monazite, which is the source from which the thoria now used is obtained, is mainly composed of phosphate of cerium and lanthanum, together with the phosphates of other rare earths, amongst which is thorium in quantities varying from a little over 1 to 16 per cent. and traces of many other bodies. This mineral, which used to be considered extremely rare, has now been found to be very widely distributed, its chief sources being the United States, Brazil, Siberia, Canada, &c., where it is found in the form of sand produced by the disintegration of primitive rocks.

Ceria being the main constituent of the monazite, and occurring in far larger proportion than the thoria, is separated with a much greater degree of completness at the present time than was the case with the thoria made from orangite and thorite; indeed, it was only a few observers who, prior to 1890, had stated that thorite and orangite contained ceria.

Small as is the percentage of thoria in monazite, and laborious as is the separation of the thoria from it, the discovery of these large supplies of the mineral has reduced the price of thorium nitrate, according to Dr. Hintz, from £100 per kilo at the end of 1894 to the present price of about 30s. per kilo.

Of late years an important variation has been introduced in the manufacture of some mantles, in which while the mixture of 99 per cent. thoria and 1 per cent. ceria was employed, the principle under which the old Clamond basket was made has been pressed into service. As pointed out in the previous lecture, these baskets were made in the early eighties by weaving together filaments which had been formed by squeezing a paste of magnesia and magnesium acetate through a suitable orifice, and the woven mantle when baked could be rendered incandescent by means of an ordinary burner owing to the threads being reduced to a sufficient degree of fineness.

In November 4, 1890, Lungren took out a patent for an improvement in the method of manufacturing the mantle, which was a great advance on Clamond's original process. In this latter method it was found that it was a troublesome matter to get a coherent mantle owing to the threads at the points of intersection not welding properly, the first threads laid on the mould drying before the cross threads were put on, so that, when they were pressed together, the dried threads cut through the softer ones and did not properly unite with them. In order to overcome this, Lungren mixed his refractory earths into a paste with some combustible elastic material, and from this squeezed out the threads from which the mantle was woven, after which operation the elastic binding material was burnt out. As examples of suitable materials Lungren instances glue mixed with glycerine, india rubber dissolved in naphtha, &c., and states that a variety of materials may be used.

At the present day collodion is rapidly coming to the front as a vehicle for holding the incandescent oxides. This substance has a very interesting history. In 1838, Pelouze discovered that when paper was treated with the strongest nitric acid it was rendered exceedingly inflammable, and in 1845, Schönbein, the Swedish chemist, proposed the use of nitrated cotton-wool as a substitute for gunpowder, and showed that its combustion gave no smoke.

Several factories were soon at work making guncotton for explosive purposes, but several disastrous accidents taking place for which no apparent reason could be found, and guncotton being found unfitted for guns the works were stopped, and it was not until late in the sixties that guncotton was made on a manufacturing scale as an explosive. Meanwhile, however, it had been found that if the strength of the nitric acid was not kept up a lower form of guncotton was produced, which was not of much use as an explosive, but which could be dissolved in a mixture of alcohol and ether, and that when these solvents had evaporated off a structureless semi-transparent mass was left. Many commercial adaptations were soon found for this material, and its manufacture was started on a large scale.

Amongst the many other applications of collodion it has been employed for the manufacture of artificial silk, and large factories have been built in many parts of Europe for

this purpose. In one process wood pulp is converted into collodion by nitration and this collodion is then dissolved in as little alcohol and ether as possible. In order to obtain the fibre the thick solution is forced by enormous hydraulic pressure through capillary glass tubes, the bore of which is less than the one-hundredth of a millimetre. Ten to twelve of the expressed fibres are twisted together and wound on to a bobbin, the air of the room being kept sufficiently heated to cause the drying of the filaments a few inches from the orifice of the tube. The compound thread is next denitrated in order to remove the extreme inflammability which it possesses at this stage, and for this purpose the skeins are dipped in a solution of ammonium sulphide by which they are converted into ordinary cellulose. The skeins are then washed and dried, the resulting product requiring an expert's experience to detect it from ordinary silk.

In 1894 De Mare utilised collodion for the manufacture of a mantle, adding the necessary salts to the collodion before squeezing it into thread. Following in his steps Knofler in 1895 and later on Plaissetty took out patents for the manufacture of mantles by a similar process to De Mare's, the difference between the two being that Knofler used ammonium sulphide for the denitration of his fabric, whilst Plaissetty employed calcium sulphide, the objection to which is the trace of lime left in the material.

Another method of the same kind for making artificial silk which has a considerable reputation is that known as the Lehner process, which in its broad outlines somewhat resembles the Chardonnet, but differs from it in that the excessively high pressure used in the earlier method is done away with by using a solution of a more liquid character, the thread being hardened by passing through certain organic solutions. It has been found that this form of silk lends itself perhaps better to the carrying of the salts forming the incandescent oxides than the previous solutions, and mantles made by this process, which we will speak of as Lehner mantles, show promise of being a most important development of De Mare's original idea.

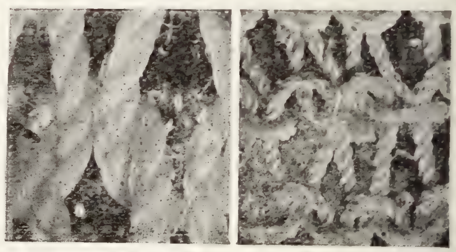
Mantles made by such methods as those of De Mare, Knofler, Plaissetty, and Lehner, are clearly developments of the Clamond hood, and not of the Auer mantle. In the Clamond class the filaments are made by squeezing a homogeneous pasty material through small orifices so as to form rods or threads, and when the vehicle holding the salts is burnt off, the oxides are left in a thread of even density.

The Auer class consists of excessively minute filaments many hundreds of which go to form a thread, whilst each filament when burnt off after impregnation with the illuminating solution leaves a minute rod of the oxides having a dense central portion which was produced by the salts by capillary attraction being drawn into the small tubes in the centre of the cotton fibre. This dense central portion is surrounded by a more or less spongy coating formed by the salts on the exterior of the fibre

Fig. 1.—Collodion Mantle.

Before Burning. After Burning.

Fig. 2.—Welsbach Mantle.



Before Burning. After Burning.

being reduced to oxides, and is kept in a broken-up condition by the escape through them of the gases from the burning fabric.

In the Welsbach mantles you have this enormous mass of small filamentary matter twisted in the thread into what after burning becomes practically a fluted column of oxides, whilst in the Clamond class of mantle you have each separate filament that forms the thread standing out separately by itself, so that what appears to the eye to be one solid filament, reveals itself under the microscope as a loose bundle of rods, which vary in number accord-

ing to the make of the mantle, those made by the Lehner process having rather more of these separate filaments than those made by the Plaissetty and Knofler methods.

This alteration in physical structure has a most extraordinary effect upon the light-giving life of the mantle, and also on its strength, as after burning for a few hundred hours the constant bombardment of the mantle by dust particles drawn up by the rush of air in the chimney causes the formation of silicates on the surface of the mantle owing to silica being present in the dust, and this seems to affect the Welsbach structure far more than it does the Clamond type, with the result that when burnt continuously the Welsbach mantle falls to so low a pitch of light emissivity after 500 to 600 hours as to be a mere shadow of its former self, giving not more than a third of its original light, whilst the Knofler mantle keeps up its light-emitting power to a much greater extent, and the Lehner fabric is the most remarkable of all. Two Lehner mantles which have now been burning continuously in my laboratory for over 3,000 hours give at this moment a higher light emissivity than most of the Welsbachs do in their prime.

I am in hopes that I have been able to trace the causes which lead to this extraordinary result, and hope at an early date to be able to give the exact reasons that determine this phenomenon. In any case it may be stated that the trouble with regard to the length of useful light emission is practically solved, and that the new developments of the Clamond process form as important a step in the history of incandescent gas lighting as the discoveries which gave rise to the original mantles.

*THE MAKUM COALFIELD, ASSAM.**

Although coal of superior quality has been known to exist in Assam for many years, it is only recently that steps have been taken on a large scale to open out and develop any of the known coalfields. One of the earliest records, if not the first, of Assam coal was made by Lieutenant Wilcox in 1825, but this was of coal outcropping near the Desang river, some considerable distance from the Makum field. This record, however, does not state the exact locality in which it was found, or give any particulars as to its mode of occurrence. Subsequent discoveries were made of coals outcropping in the rivers and hills, and about the year 1840, a small quantity of coal was quarried by the Assam Tea Company, near Jaipur, twenty miles south-west of Makum. Small quantities of coal were apparently also raised in Makum about the same period, but little or no mention of the Makum field was made until the year 1865, when Mr. Medlicott, of the Geological Survey of India, was deputed to examine and report on the Assam coalfields generally. Although several fields are mentioned by him as being more advantageously situated, *i.e.*, closer to the rivers, than Makum (the rivers in those days being the only means of conveyance), yet, he reported, "these advantages are outweighed by the superiority of the Makum coal," which he considered to be *the* coalfield of Assam.

Subsequently small quantities of coal were quarried in the Makum field, near the Tirap river, which runs into the Dehing, but owing to the difficulties of transport nothing was extensively done. This will be easily understood, for, at this period, railways and tramways were unknown in Assam, and some of the rivers which empty themselves into the Brahmaputra are navigable only during the rains, or for about seven months of the year.

In 1874 and 1875, at the request of the Assam Government, Mr. F. R. Mallet, of the Geological Survey of India, made an examination of the Assam coalfields. The survey was made under great difficulties, the hills being covered with dense jungle, and owing to the unfriendly attitude of the hill tribes (Nagas), the party had to be provided with an armed escort of Frontier Police. This report, which is very interesting and exhaustive, was afterwards published by the Government. He gives a full description of the coal measures, which consist of alternating sandstones, coal and shales. The age is probably nummulitic. In the area under consideration, there is practically no limestone or ironstone, small nodules of the latter being very rarely met with. Fossiliferous foliage is often seen in some of the coals and clays.

Nothing was extensively done in Makum until the advent of the Assam Railways and Trading Company Limited, which, in 1881, was formed in London, to make a railway about seventy miles long from Dibrugarh, an important town on the Brahmaputra, to tap the Makum field. A concession of thirty square miles was granted to explore and open out the coalfield, which included the working of the oil (known to exist since the time that coal was discovered), brickworks, sawmills, &c. The railway, which is metre gauge, commences at the steamer Ghat, Dibrugarh, and runs to Makum Junction, a distance of thirty-nine miles. Here it branches off in two directions, one branch of sixteen miles going to Talup, connecting with extensive tea gardens, and the other branch going to Margherita, a distance of twenty-three miles. The track for fifteen miles, until Digboi is reached, is through virgin forest. Margherita was the first clearance and settlement which the company originally made in the vast stretch of forest in which the Makum coalfield lies, and is situated on the

* Abstract of a paper read before the Manchester Geological Society, June, 1900, by George E. Harris, M.E. From the *Colliery Guardian.*

Dehing river, about two miles east of Makum fort, and sixty-two miles from Dibrugarh by the railway. It is practically the centre of the industries of the Assam Railway and Trading Company. Eight miles north of Margherita is the company's oil territory at Digboi, and two miles south is the Makum territory. Adjoining the station are the company's large saw-mills, colliery workshops and refinery; 4½ and 6½ miles east of Margherita are the Tikak and Ledo collieries and brickworks, and south-east lies the Namdang Colliery.

The collieries are situated in the first spur of the Naga hills, in the Lakhimpur district. A good deal of coal and coke is sold locally, but the bulk is shipped at Dibrugarh, supplying the river steamers and tea gardens on the Brahmaputra. Some coal is also supplied in Calcutta to ocean-going steamers. The company's railway is the only one at present connected with the collieries, but the Assam Bengal Railway is likely to be connected shortly, and will undoubtedly afford a new outlet for Makum coal. Except where tea-garden clearances have been made, the surrounding country is a dense forest and jungle. The south surface of the coalfield is undulating, the hills and valleys, with numerous mountain streams, forming a very picturesque country. The highest point at which coal is extracted is about 1,000 feet above the plain. In the immediate background are the Patkoi mountains, which enclose a pleasing panoramic view. On clear days, in the opposite direction, may be had an extensive view of miles of forest, interspersed with winding rivers. There are a few Naga villages on the hills near the collieries. Previously the Naga population was numerous, but on the advent of the railway, a large portion of the population cleared away into the interior. The inhabitants of the immediate surrounding villages are friendlies, and more or less civilised. They are, as a race, incorrigibly lazy, having no industry of any kind. They cultivate, as a rule, sufficient grain for their own consumption. They are a hardy and strong race of people, but they do not care for work, and nothing will induce them to commence mining, consequently all labour has to be imported. A few of the local Nagas, who are more civilised than the rest, occasionally do jungle clearing. They are adepts at this work, and their services are gladly employed by companies who require heavy jungle clearances. The Assam Railways and Trading Company have made four clearances and settlements near the mines—viz., Margherita, Tikak, Ledo, and Namdang.

Tikat settlement, which is the highest point of the outcrop, is 750 feet above the plain. There are about 500 coolie miners at Tikak. At Ledo the coolie houses are built—some of brickwork, others on rail posts, and some have brick pillars only, with bamboo sides and thatched roofs. The settlement is well drained by a small river, the Ledo, from which the name is taken. There are about 1,200 coolie colliers in Ledo at present. In addition to these there are the brick and pipe-works people, as well as others who are employed on miscellaneous works, the total population being about 2,000.

Namdang is the newest clearance and settlement made by the company for their colliery at Namdang, the first coal being sent away in 1897. There are at present about 400 coolie miners here. The houses are placed on a hill some 250 feet above the mine entrance, and are much the same as those already described.

Collieries have been opened out east and west of the rivers Ledo, Tikak, and Namdang, and proved the existence of coal seams much thicker than were originally believed to be. The Ledo collieries have been driven out nearly a mile, Tikak colliery more than a mile, and the new colliery at Namdang more than half a mile. With the exception of a seam of coal 8 feet thick which has been worked at Upper Ledo colliery owing to the erosion of the thick seam, the only coal worked at present is that known as the thick seam. This valuable seam is in reality made up of three or four seams, aggregating about 50 feet thick, and known as the top, middle, and bottom coals.

The coal is an excellent steam coal, and undoubtedly the best found in India, its calorific value being considerably higher than any other known Indian coal. It cokes freely, the coke being of excellent quality. The analysis of the outcrop coals made by the Geological Survey of India averaged:—

	Per cent.
Fixed carbon	60·5
Volatile matter	34·8
Ash	2·2
Water	2·5
	100·0

After mining operations had been commenced, a further analysis was made of the coal taken from inside the mine, the results being:—

	Per cent.
Fixed carbon	75·70
Hydrogen	6·04
Oxygen and nitrogen	13·11
Sulphur	1·39
Ash	1·12
Water	2·64
Gas per ton	10·900 cubic feet.
Illuminating power	17·2 sperm candles.
Coke	11 cwt. to the ton.

It will be seen from the above that Makum coal compares very favourably with best English coals. The seams are highly inclined, those at Tikak and Ledo being about 1 in 3 (19 degs.), dipping south-east. At Namdang the seams are very steep, viz. 45 degs. A peculiar feature of the coal is its fineness when extracted. In the "whole" it is fairly hard and compact, the roadways standing well, little timbering as a rule being necessary if the roads are not made more than about 6 feet square, but in the broken a large portion of it breaks up into very small pieces, resembling fine slack. Owing to

its cleanness and excellent coking qualities this is not of much consequence. It, however, causes a good deal of anxiety in mining, as fires from spontaneous combustion are very frequent. In addition to the coal-seams already described, there is, in the plain, about half-a-mile north of the outcrops in the spur of the hills, another outcrop of the thick seam. The inclination is 45 degs., but the direction is north-west, or the reverse of the other seams. Between these outcrops is half-a-mile of undulating barren ground, the break being an anticlinal fault, which can be traced along the foot of the hills for some miles. A good deal of the outcrop of this latter seam was quarried by the company from 1884 to 1886, a thickness of 40 feet having been proved. Owing to water in these workings, they were abandoned directly the collieries in the hills had been opened. This seam, no doubt, will be worked in the distant future. Inclines and shafts will have to be made, the working cost being greatly enhanced by the addition of large pumping plants which will be inevitable owing to large quantities of water that will be met with in dip workings.

In 1885, the output of coal was 43,000 tons; 1890, 145,700; 1895, 173,500; 1899, 228,000 tons, giving an average of about 10 cwt. daily per person employed, including surface and underground. This is higher than the average of most Indian collieries.

Undoubtedly the great drawback to enterprise in Assam is the scarcity of labour, the colony being very sparsely populated. Local labour is not obtainable, and it is therefore necessary to import coolies from the congested districts of Bengal, &c. The want of labour in Assam is seriously felt by all industries, and is, in most cases, a very expensive item in their working economy. More especially is this felt in coal mining, the conditions of work being so totally different from most kinds of work. The coolies being essentially agriculturists, they do not, as a rule, at first take kindly to colliery work.

ROMAN MORTAR.

In connection with some excavations for a drain in the Old Bailey, Mr. J. Terry, clerk of the works to the Corporation of London, discovered a portion of the Roman wall. Some specimens of the mortar were supplied to the editor of the *Builder*, and the following account of the analysis of the mortar is taken from that journal:—

Two samples of the mortar were taken from the interior of the old wall in Old Bailey, and may reasonably be regarded as genuine specimens of Roman work. One sample was a piece weighing rather more than one pound, the other a piece weighing rather more than half a pound. Both samples contained a number of water-worn pebbles, varying in size up to a maximum of about 2 in. by 1½ in. For analysis the whole of each sample, including pebbles, was crushed to powder, except one small piece, which was treated with dilute acid, in order that the uncrushed sample might be examined after the removal of the lime. From the appearance of the sand and pebbles thus separated, it was concluded that *unscreened* river sand was the description of sand employed. The lime and sand had been well mixed, for the mortar was almost entirely free from those small isolated lumps of lime or lime carbonate which are an indication of faulty mixing. Both samples were in excellent condition, and of great strength.

The following results were obtained by analysis, and it will be seen that the two samples were practically identical in composition:—

	No. 1. Per cent.		No. 2. Per cent.
Water (lost at 212 deg. F.)	1·65	..	1·84
Combined water and organic matter	2·51	..	3·03
Earthy matter, after ignition (Dibdin and Grimwood test) ..	4·87	..	4·11
Sand, including pebbles	64·75	..	66·46
Silica, soluble in 10 per cent. HCl	1·00	..	1·57
Oxide of iron do.	0·66	..	0·66
Alumina do.	0·44	..	0·14
Lime do.	15·15	..	13·80
Magnesia do.	0·04	..	0·04
Carbon dioxide..................	8·46	..	7·95
Sulphur trioxide	0·15	..	0·18
Other matter and loss	0·32	..	0·22
	100·00		100·00
Silica soluble in 10 per cent. soda (Hughes' Test)	8·95	..	10·85
Caustic or slaked lime uncombined	None.	..	None.

The "earthy matter" and "sand" in the above analyses were obtained by treating the mortar by the method advocated by Messrs. Dibdin and Grimwood, the chemists to the London County Council, in a paper communicated by them in 1896 to the Society of Public Analysts. The earthy matter and sand, dried at 212 deg. Fahr., thus obtained from sample No. 1, were subsequently analysed, and were found to have the following composition:—

	Earthy Matter. Per cent.		Sand. Per cent.
Combined water and organic matter	6·88	..	0·29
Oxide of iron, soluble in concentrated HCl	4·01	..	2·65
Alumina, soluble in concentrated HCl		..	trace
Oxide of iron, as insoluble silicate	1·72	..	0·96
Alumina do.	2·67	..	
Lime do.	0·57	..	0·76
Silica, soluble in 10 per cent. soda	59·11	..	5·00
Silica, crystalline or as insoluble silicate	21·27	..	89·98
Other matter and loss	3·77	..	0·36
	100·00	..	100·00

Before proceeding to calculate the relative proportions of lime and sand employed, it is necessary to consider the composition of the earthy matter and sand. The substances vaguely described as "earthy matter" are substances which, when tested by the Dibdin and Grimwood test, which consists in repeatedly stirring the mortar with dilute hyhrochloric acid and decanting off with the solution all insoluble matter which does not fall to the bottom of the containing vessel in one minute, are supposed to be deleterious to the strength of the mortar. The analysis of the earthy matter, however, shows that in the present case more than half the earthy matter consists of silica, soluble in caustic soda, which is a valuable constituent of a mortar instead of an objectionable one. The Dibdin and Grimwood test is an excellent one if the earthy matter obtained be examined before assuming that it is wholly composed of matter injurious to the building quality of the mortar.

Hitherto two mistakes have commonly been made regarding the chemistry of lime mortars. It has been assumed that (1) only that form of silica in lime which is soluble in hydrochloric acid is capable of combining with the lime to form a silicate, and (2) no chemical reaction takes place between the sand and the lime. In Portland cement the whole of the silica is soluble in acid, but good building lime and building sand both contain a certain quantity of silica in a form that is neither crystalline, as quartz sand, nor soluble in hydrochloric acid. This form of silica is soluble in caustic soda solution, and is found in all lime mortars of great strength in comparatively large proportion.

In June, 1892, Mr. John Hughes published in the *Builder* a number of analyses of mortars taken from the various ancient abbeys and castles of the United Kingdom. In this paper he clearly showed the importance of the presence of this silica soluble in soda. (For convenience, this soda-soluble silica will be referred to in this paper as *amorphous* silica, while that soluble in hydrochloric acid will be termed *soluble* silica.) Mr. Hughes, however, wrongly assumes that "it is in this form that most of the silica exists in Portland cement, the actual figures being from 20 to 22 per cent." A glance at the analyses of these Roman mortars will show that there is a difference of 8 or 9 per cent. between the quantity of the two forms of silica. That not only is the *amorphous* silica present in the mortar in a different form to the *soluble* silica but also is present in much larger proportion. Mr. Hughes also regards the amorphous silica as being present with the lime rather than with the sand, whereas, as a matter of fact, it should be present in both lime and sand. Quite recently a paper has been published by E. Donath, in the *Thonindustrie Zeitung*, which confirms this statement that building sand almost invariably contains more or less of this amorphous silica.

The quantity of carbon dioxide present in the Roman mortars is sufficient to combine with about two-thirds of the lime only; therefore, about one-third of the lime must be present in combination, since practically no lime in an uncombined condition remained in the mortar. By deducting the lime required for combination with the carbon dioxide, Mr. Hughes obtained the following striking figures:—

	Constructed Circa.	Amorphous Silica.	Lime as Silicate.
Rochester Castle	1088 A.D.	1·6	1·7
Corfe Castle	1000 ,,	7·5	1·5

Thus showing that the Corfe Castle mortar, which is referred to as of extraordinary strength, has a large proportion of its amorphous silica uncombined with any base, for neither the iron nor the alumina present amounted to 1 per cent. The Rochester Castle result negatives the theory that in course of time the lime may react upon the crystalline silica.

Reference to the analysis of the "sand" obtained from the Roman mortar will show that 5 per cent. of *amorphous* silica remained with the crystalline sand and crushed pebbles. By Mr. Hughes' test the whole of the chemically active silica—both *soluble* and *amorphous* — is obtained.

The analyses indicate that the proportion by *weight* of the lime to the sand used by the Romans in manufacturing the mortar for the London Wall was about one to four. The conversion of parts by *weight* to parts by *volume* is, in a case of this description, more or less a matter of guesswork, but accepting the figures given in Hurst's handbook, showing that one cubic foot of stone lime in lump weighs 55 lbs., and one cubic foot of Thames sand weighs 103 lbs., then the proportion of lime to sand becomes about one to two.

Chemically considered, the mortar is good, because (1) the proportion of lime to sand by volume is about one to two; (2) the proportion of silica soluble in sodium hydrate is high; and (3) the proportion of clay and organic matter present is very small.

There is, however, nothing mysterious about the Roman mortar. Mr. Hughes observed that in all his analyses of ancient mortars "in no case did the proportion of sand to lime exceed in round numbers that of two to one, which is very much less than that found in modern mortars." The Roman mortars in existence at the present day are mostly found in military or government work, which was, no doubt, constructed under strict supervision. Probably jerry-builders were as well known to the Romans as they are to us.

So far from being more ignorant than the Romans of the art of mortar manufacture, we possess in the fine grade Portland cement of to-day, cementing material of much greater utility than anything they ever knew.

Correspondence.

DRUMMOND LIGHT.

Professor Vivian B. Lewes, in his very interesting lecture on "The Incandescent Gas Mantle and its Uses" (as reported in the *Journal* of 19th inst.), begins his third paragraph by saying:—"Producing light by heating refractory bodies to incandescence is entirely an outcome of the 19th century, and dates from 1826, when Drummond first showed that a piece of dense lime could be raised to intense incandescence by the heat of the oxy-hydrogen blow-pipe flame."

Not only Professor Lewes but all the leading text-books on Chemistry give Drummond the credit of this discovery. An examination of the literature of the period seems to show, however, that this fact was established by the experimental work of Sir Goldsworthy Gurney (b. 1793 d. 1875), and it is described in his work, "A Course of Lectures in Chemical Science," where an illustration is given of the apparatus he designed and constructed for the purpose. The original apparatus, it may be remarked, has been lately presented to the Victoria and Albert Museum, where it is exhibited among the cases of historical apparatus, but without description.

The following paragraph from the "Dictionary of National Biography" places Gurney's claim in a still clearer light. "He (Gurney) discovered the powerful lime-light known as the Drummond light, because first used by Thomas Drummond (1797-1840) in his trigonometrical survey of Ireland in 1826-7. But Drummond, in a letter to Joseph Hume, Chairman of a Committee of the House of Commons on lighthouses, stated that 'he had no claim to the invention of the light for he had it from Mr. Gurney in 1826.'" The article proceeds:—"Gurney, at the request of Sir Anthony Carlisle, made some experiments in crystallisation and the lime-light before the Duke of Sussex and King Leopold, and the Duke personally presented him with the Gold Medal of the Society of Arts, voted for the invention of the blowpipe."

The point raised is perhaps unimportant and does not of course effect the scientific facts, but since Prof. Lewes's first lecture was largely due to a historical survey of the subject, and the credit of pioneering work is at stake, he will perhaps excuse this note.

J. Paul de Castro.

School of Mines, Redruth, Cornwall.

WATER-GAS.

I have read in your issue of the 19th inst., the print of Professor Vivian Lewes's first Cantor lecture on the "Incandescent Gas Mantle and its Uses," in which (p. 842) Professor Lewes attributes to Gillard, in 1848, the manufacture of water-gas by introducing the principle of raising carbonaceous material to incandescence in a cupola furnace by an air-blast and then injecting steam to form the water-gas until the temperature fell, when the steam was cut off and the fuel again "blown" up to make the water-gas once more, a process which is the basis of all modern water-gas practice. Then he goes on to say that Gillard devised a cap of fine platinum wire which was suspended in the flame and heated to incandescence.

What might have been Gillard's practice in the environs of Paris, in a portion of which his mode of lighting was, for a time, adopted, I don't know, but I do know that in England, where an experimental plant was put up at Vauxhall Gardens in the winter time—which plant I was requested to examine and report upon—Gillard used every effort to get rid of carbon monoxide, and to obtain as much hydrogen as possible.

To this end he employed an apparatus consisting of an ordinary horizontal gas retort, continuously heated by an external fire, having wood charcoal lying in a thin layer upon the bottom of the retort, and having, near the upper part, three or four horizontal gas pipes (introduced from the front end of the retort) perforated on their underside. These pipes were fed with steam from a boiler, and they discharged the steam downwards on to the incandescent charcoal lying on the bed of the retort, with the result of decomposition and the production of hydrogen, carbonic acid, and some carbonic oxide.

Gillard claimed for his contrivance of forcing a jet downwards on to the incandescent charcoal, that, immediately the decomposition of the steam was effected, the products rose away from the charcoal, and that the carbonic acid was thereby prevented from taking up a further dose of carbon, and from being converted into carbonic oxide. The carbonic acid was got rid of by lime purification.

I saw this apparatus at work, as I have said, at Vauxhall Gardens, and I saw it in the house of a Mr. Kurtz, who was, I think, a chemical manufacturer, or colour maker—I forget which—who lived in the environs of Manchester.

Frederick Bramwell.

5, Great George-st., Westminster, S.W.
23rd October, 1900.

ARTIFICIAL LIGHT OF THE SAME CHARACTER AS DAYLIGHT.

I have read with much interest the article in our *Journal* of Sept. 21st, entitled "The Production of an Artificial Light of the same character as Daylight." (See *ante*, p. 800.) It is much to be regretted, however, that Messrs. Arthur Dufton, and W. B. Gardner, in their paper read before the British Association at Bradford, on the above subject, made no mention of the acetylene light. One of the strongest characteristics of this light is that all colours appear practically the same as in daylight. It is therefore the light, *par excellence*, for dyeing and colour printing. In Germany, and at Roubaix and Lille in France, acetylene gas has been used for some time with great success in dyeing and colour-printing works.

Dr. Rose, H.B.M. Consul at Stuttgart, recently made the following statement in a report sent to the *Journal of Acetylene Gas Lighting*:—"In Alsace the dyeing and printing factories have recognised the great importance of an illuminant which allows colours and tints to be as clearly distinguished from one another as in sunlight, and have adopted it without delay. The result has been a great saving to them, as with the former systems of electric and Welsbach lighting four times as much loss was caused by defective colouring and tinting, in some cases the saving effected was so considerable that the cost of the acetylene installation was covered during the first year."

Liebertanz, the author of one of the most complete and reliable text-books on acetylene hitherto published, states on p. 297 of the work, "The colour of the acetylene flame is absolutely white. Microscopical examination of coloured preparations can be carried on with acetylene light without using blue glasses. The brightest citron yellow can be distinguished by acetylene light from a shade only a trifle darker, in fact, all colours in every shade show up clearly and plainly."

Professor Vivian Lewes, in his lecture on the "Welsbach Mantle," read before our Society, furnished a Table, contrasting the characteristics of various luminants. (See *ante*, p. 847.)

It will be seen from this Table that when acetylene gas is burned under proper conditions in an atmospheric burner, the spectrum in two cases, viz., red and yellow, may be accepted for all purposes, the same as sunlight. In the blue rays there is an increase of 0·46, which bring them to about the same value as the Northern light. The violet rays show a slight increase, so that acetylene light is even richer than sunlight in the rays which are so essential to the chemical action of light, and yet the red rays which are so detrimental in colour work do not predominate, as in the arc light. The advantage of the acetylene light, for all colour trades is therefore manifest.

On July 3rd, Mr. Charles Bingham, of the Giffre Electro Chemical and Power Co., wrote to Mr. Z. H. Heys, of the Calico Printing Association, Limited, Manchester, offering to arrange for a practical demonstration of the light, and he also furnished the names of firms in Augsburg, who have thoroughly proved the value of acetylene gas for textile work. I feel sure Mr. Bingham would be prepared to renew his offer to any responsible firm connected with dyeing and colouring. As regards cost, carbide can now be obtained in England at £20 per ton delivered. The average yield of acetylene gas from one ton of carbide is 10,000 cubic feet; taking 36 candle-power to the cubic foot, it is equal to coal-gas at 3s. 6d. per 1,000.

As an illuminant, acetylene is healthier than coal-gas, and is certainly not more dangerous.

F. W. Harker, M.S.A.,
Managing Director of the "Phôs" Acetylene Gas Syndicate, Ltd.
October 23, 1900.

Obituary.

William Luson Thomas, R.I.—The Society of Arts has lost a prominent member in Mr. Thomas, who died on the 16th inst., at his house in Chertsey. He took great interest in the Society's work, and has been a member of the Council since 1897.

Mr. Thomas was born at Bath, on December 8, 1830, the son of a London shipbroker, and was educated at a private school at Fulham. At the age of sixteen he went to Paris to join his elder brother George, and shortly afterwards the two brothers, with George's partner and brother-in-law, Mr. H. Harrison, went to the United States to assist in launching two newspapers, the "Picture Gallery" and the "Republic." From New York the brothers went to Rome, where Mr. William Thomas spent two years. He then became associated with Mr. W. J. Linton, the famous wood-engraver, to whom he was articled, and subsequently he started an engraving establishment of his own. He spent his spare time in painting, exhibiting at the Royal Institute of Painters in Water Colours of which institution he was a member. He was largely instrumental in transferring the Institute from Pall-mall to new quarters, and he helped to raise the capital required for the new galleries in Piccadilly. Mr. Thomas did a large amount of work for the *Illustrated London News*, and in 1869 he established the *Graphic*. The originality of the scheme, as he himself stated, "consisted in establishing a weekly illustrated journal open to all artists, whatever their method, instead of confining my staff to draughtsmen on wood, as had hitherto been the general custom. Added to this as an attraction I hoped to enlist the services of writers of some literary distinction." Mr. Thomas gathered a brilliant group of artists around him and initiated a revolution in the production of illustrated artistic newspapers.

Ten years ago he started the *Daily Graphic*, a very bold venture, the success of which has, however, fully justified itself. The establishment of a daily illustrated paper had been his long cherished dream.

Mr. Thomas was highly esteemed by all who knew him, and how greatly his life-work and influence was appreciated by the artists of England is seen from Professor Hubert von Herkomer's letter to *The Times*. Mr. Herkomer wrote, "He did more than improve illustrated journalism, he influenced English art, and that in the wholesomest way. It is not too much to say that there was a visible change in the selection of subjects by painters in England after the advent of the *Graphic*. Mr. Thomas opened its pages to every phase of the story of our life; he led the young rising artist into drawing subjects that might never have otherwise arrested his attention; he only asked that they should be subjects of universal interest and of artistic value."

Mr. Thomas presented the Society with Mr. Sydney Hall's drawing of a meeting of the Council, which was produced in the *Graphic* last June.

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FRIDAY, NOVEMBER 2, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

*DEATH OF MR. ROOM.**

The Council deeply regret to have to announce to the members the death of Mr. Howard H. Room, the Accountant of the Society, which took place on the 26th October. Mr. Room's connection with the Society extended over a period of thirty-nine years, and his intimate knowledge of its affairs was united to a thorough devotion to its interests.

The Council feel that the large number of members to whom Mr. Room was personally known will sympathise with this expression of esteem and sincere regret for the great loss which has befallen the Society by his death.

EXHIBITION OF MODERN ILLUSTRATION.

The arrangements for this Exhibition are progressing satisfactorily. It will be held in one of the Upper Galleries of the India Museum on the West side of Exhibition-road, which forms part of the Victoria and Albert Museum, South Kensington, under the authority of the Board of Education. It will comprise typographical reproductions and the original drawings by leading artists executed since 1860, and it will demonstrate the progress made in the production of line and half tone process blocks since that time. Wood blocks will also be exhibited which were drawn upon by such artists as Lord Leighton, Sir J. E. Millais, Frederick Walker, George J. Pinwell, and A. B. Houghton, some of which have been engraved by the best engravers in this period. A considerable number of works from artists, who have been invited to contribute, have already been received, including some excellent representative examples of German and Spanish Art. Similar works are expected from France, Sweden, Norway, Denmark, Russia, America, and other countries, which it is believed will make the Exhibition in every way complete. The Exhibition will, probably, be ready to be opened at the end of November or the beginning of December.

* The Obituary Notice of Mr. Room is given on p. 875 of this Number of the *Journal.*

Proceedings of the Society.

CANTOR LECTURES.

THE INCANDESCENT GAS MANTLE AND ITS USES.

By Vivian B. Lewes.

Professor of Chemistry, Royal Naval College, Greenwich.

Lecture III.—Delivered May 21, 1900.

The history of the incandescent mantle has not been altogether devoid of attempts to introduce forms suitable for flames other than these given by the Bunsen burner with a circular tube. First and foremost amongst these in the inception of incandescence came the Fahnehjelm comb, made of a number of thin magnesia rods, set in a back of fire-clay, supported by an iron frame clamped above a small Bray burner, in which water-gas was consumed. The comb, however, as has been before stated, burnt away in less than 100 hours owing to the volatility of the magnesia, whilst the light which it emitted even in its prime only amounted to 3 or 4 candles per cubic foot, although it was afterwards found that dipping in a solution of chromic acid brought this up to nearly double value, and increased fourfold the life of the burner.

When the idea of making a fabric was firmly established and the mantles began to be a success, De Marc tried to utilise the flat flame as a source of heat in which to excite a fringe of fabric soaked in a mixture of the salts of the rare earths and burnt off so as to give a comb of very fine oxide filaments. The effect produced by this when properly arranged was extremely good. In the burner employed for this purpose he first tried what was practically a flat-flame Bunsen, which gave very good results, and later he employed a burner in which the coal-gas *per se* was forced out into the air in so thin a sheet that the hydrocarbons in it became thoroughly consumed, and a non-luminous flame was produced. It was possible to do this in Paris as the gas sup-

plied was only 14 candles, and the pressure at which it was distributed four to five inches, so that by using a very small Bray nipple a thin non-luminous flame was produced, which, owing to the admixture of air being only just sufficient to give the desired effect, was hotter than the flat Bunsen flame. It was attempted to introduce these De Mare plumes into England, but the rare earths employed were held to be the equivalent of the earths protected in Welsbach's 1885 patent.

Another very effective variety of incandescent is to be found in the De Lery burner and its cluster of baby mantles or tassels. Taking a Bunsen burner with a dome top in the sides of which holes were pierced at regular intervals, De Lery obtained a circle of small Bunsen jets, each of which raised to incandescence a small tassel of the oxides of thorium and cerium. These tassels were suspended from a twelve armed circular support, and hung in the corresponding number of flames issuing from the top of the burner. The effect given is most excellent, as the spreading of the incandescence over a considerably larger surface prevents the irritation of the eye so prevalent with the ordinary mantle, whilst the diffusion of light obtained in the room is distinctly superior.

I have already on more than one occasion pointed out the great difference which exists between the measurement of illuminating power as carried out on the photometer, and the illuminating effect which one obtains from illuminants in practice. The De Lery tassel burner is as good an example of this phenomenon as can be found, for although it gives less light than the ordinary incandescent mantle, when tested at the horizontal in the photometer, its illuminating effect is far superior, and the light, being mostly cast in a downward direction, illuminates the surface below the burner, whilst with the ordinary mantle the bulk of the illumination is thrown from the horizontal upwards, owing to the form of mantle being a cone. These burners with their tassels have proved very successful in America, and I am informed that they will shortly be introduced into this country, when their novelty of appearance and excellent effect will undoubtedly go a long way towards making them a success.

Attempts have also been made to strengthen and increase the amount of light obtainable from the ordinary shape of mantle, a noticeable endeavour in this direction having been made by Plaissetty, who noticing the great intensity of heat produced over the small area immediately above the burner top and the tendency which mantles had to shrink at this spot, attempted to both strengthen the mantle and increase its light emissivity by braiding the mantle with clocks or seams of the same incandescent material as that of which the mantle itself was composed. The result, however, did not give promise of any very great increase in illuminating power, and the idea has been, I believe, abandoned. Plaissetty also made mantles consisting of plaited bands of ropes, each perfectly distinct from the other, which were hung from a central support around the mantle head, and which could be burnt off by the consumer, as no shaping was required.

Leaving now the subject of the mantle which is heated to incandescence, let us pass on to the burners, which have from time to time been improved and altered in order to give the highest attainable candle power from the incandescent mantle.

It was Davy who first showed that when a jet of coal gas is allowed to pass under pressure from a small orifice and is then burnt upon the surface of a piece of wire gauze held an inch or two above the exit pipe, the flame is kept from flashing back to the exit owing to the high conducting power of the gauze, and it becomes non-luminous, a result which he correctly ascribed to the gas mingling with the air in its upward passage. As he supposed, the combustion of the carbon is so rapidly completed as to prevent the presence of any solid particles that could be heated to incandescence. The concreting of this idea into the burner that has done so much for the utilisation of gas as a fuel and an illuminant is due as I have shown to Roscoe and Bunsen, and simple as the adaptation was, it forms a link in the chain that supports the great gas industry even more important than Welsbach's valuable discovery.

In the early form of burner made by Bunsen the gas issued from either a flat flame or an Argand burner head into a metal cylinder open at the bottom and closed at the top by means of a disc of fine wire gauze, so that the gas issuing from the burner head passed upwards through the air in the cylinder, and mixed with it, the mixture burning on the top of the gauze. The difference between this class of burner and those which succeeded it was that the uprush of the gas and its mingling with the air was due simply to the velocity with which it left the burner and to the fact that the specific gravity of the gas is less than half that of air.

Very soon, however, it was found that a more rigid flame and one more easily under control could be obtained by utilising the pressure under which the gas was delivered at the burner to produce the effect of an injector. Then the uprush of the gas drags in air through side holes arranged at the bottom of a vertical burner tube placed above the gas nozzle. In order to do this a small jet or series of orifices discharged the coal-gas into a small chamber surmounted by the upright burner tube, and either the walls of the chamber or the lower portion of the tube were perforated with an opening or openings in connection with the air. On opening the gas tap the coal-gas is discharged through a jet with a velocity dependent upon the pressure of the supply, and rushing upwards and impinging upon the sides of the tube above, it acts in the same way as the steam in a Giffard's injector. By drawing up from the chamber the air which is present there it forms in it an area of low pressure, and so sucks in more air through the lateral holes to re-establish equilibrium, this action continuing, and the formation of the mixture of gas and air in the tube going on, as long as the gas continues to flow.

In this arrangement it is manifest that by regulating the size of the hole in the gas jet and the lateral air-holes, it is possible to adjust the mixture of air and gas formed in the tube with the greatest nicety, and to obtain a perfectly non-luminous and fairly rigid flame at the top of the burner.

After burners, however, have been in use for some time, no matter how well they may be regulated at first, the partial stoppage of the injector tip by dust particles and other causes acting upon the jet and air supply, frequently derange the ratio of the two supplies, and the result is than in a laboratory or other place where a large number of Bunsen burners are used, a wide discrepancy can be noticed in the flames given by the burners. In some the gas is burning with a slightly luminous top, and the inner zone is barely visible; in others the normal conditions exist, and you have a well-marked violet inner zone and a non-luminous lilac outer zone; in others, again, the flame is somewhat shortened, showing a distinct greenish tint in the inner zone, with a pale lilac outer zone, and it is generally found that when this point has been reached the flame has more or less a tendency to roar, and will flash back in the burner tube and ignite the gas as it issues from the jet.

These appearances all mark different ratios between the air and gas in the mixture passing up the tube. When one sees a slightly luminous tip, it means that the gas is mixed with less than twice its own volume of air, whilst with the normal conditions obtained with the ordinary 16-candle gas, one volume of gas is drawing in 2·2 volumes of air; the violet inner zone begins to show a tendency to turn to green when the ratio has become 1 of gas to 2·3 of air, whilst another tenth of a per cent. causes the green to become most marked and the roaring to commence.

With the ordinary Bunsen burner, as used in the laboratory, it is not possible to push the admixture of air and gas beyond this point, as the admixture of air and gas in the tube is now explosive, and the flame is only prevented from flashing back to the jet below by the rate of propagation of the explosive wave being less than the upward rate of flow of the mixture, and any further increase in the quantity of air present increases the rate of the explosive wave, and so causes flashing back. If, however, the head of the burner tube be covered with a layer or layers of fine wire gauze, the power of conduction which the fine metal filaments possess, and the fact that they reduce slightly the area of the tube, and so increase the rate of flow through the orifices of the mesh, prevents the downward propagation of the wave, and under these conditions the ratio of air to gas can be raised to over 3 volumes of air to the 1 volume of gas, and the green zone shrinks down on to the surface of the gauze, and shows itself as a seething layer, in which the green colour has reverted to a very pale blue.

The importance of the regulation of the ratio between the gases having been recognised, the air-holes in most of the burners used for laboratory and heating purposes were then fitted with cut-off rings, consisting of loose rings of metal with holes in them, which could be slid round over the holes in the side of the chamber, so that when the two sets of holes coincided the full air supply could be obtained, whilst by drawing the solid metal of the ring more or less over the under holes, the area of the air supply could be reduced. In this way it was possible to adjust the condition of the flame to the work required of it.

It will be evident that it is the admixture of air with the coal-gas before combustion that causes the production of a non-luminous flame, and the old theory to account for this phenomenon was that the oxygen burnt up the hydrocarbons in the gas before their decom-

position set free any solid particles of carbon to render the flame luminous. Knapp and others, however, showed that oxygen was not necessary for the production of a non-luminous flame, but that the luminosity could be destroyed by diluting the gas before combustion with such non-inflammable and inert gases as nitrogen, carbon dioxide and steam, and the experiments of Blochmann, Landolt, and Heumann showed that nitrogen played a most important part in the action.

Some years ago I attempted to ascertain the relative importance of the oxygen and nitrogen in rendering the flame non-luminous, and for this purpose I employed a Bunsen burner, fitted at the bottom of the tube with two supply pipes instead of the ordinary gas jet and lateral air holes. Each pipe was connected with a small meter, so that the flow of gas and air could be measured. The first determination was the quantity of air that was necessary to render the flame non-luminous, and it was found to require 13·5 volumes of air for 6 volumes of gas; 13·5 volumes of air contain roughly 2·7 of oxygen and 10·8 of nitrogen. When 6 vols. of coal-gas were passed into the burner with 10·8 vols. of nitrogen, a flame was obtained which had only a slightly luminous tip, whilst with 2·7 volumes of oxygen to 6 of coal-gas a luminous flame was obtained which flashed back unless the burner was provided with a gauze top.

A Bunsen burner burning coal-gas alone gave on the photometer with 5 c. ft. per hour 5·6 candles, but with the addition of 2·2 c. ft. of oxygen 3·1 candles; using nitrogen however in the proportion of 9 c. ft. to 5 c. ft. of gas the luminosity was so feeble that it could not be read. It follows therefore that the amount of oxygen in the air necessary to destroy the luminosity does less than one-half the work. Accordingly another experiment was tried with varying amounts of oxygen, the results being as follows:—

	Candle Power.
5 c. ft. of gas alone	5·6
5 c. ft. ,, to 1·1 c. ft. oxygen	5·4
5 c. ft. ,, 1·5 c. ft. ,,	8·0
5 c. ft. ,, 2·2 c. ft. ,,	3·1 gauze used.
5 c. ft. ,, 2·5 c. ft. ,,	0·0 ,,

The next determination to be made was the amount of nitrogen that was needed in order to bring about complete non-luminosity by dilution only. Nitrogen was supplied to a coal-gas flame burning at the rate of 6·2 c. ft. per hour, and it was found that 14·2 c. ft. per hour of nitrogen were needed to effect this result, an amount which is practically the same as that of the air required before.

1 vol. of gas required 2·30 vols. of nitrogen.
1 ,, ,, 2·29 ,, air.

This seems to show that the oxygen acts merely as a diluent, but if this were so then mixtures of oxygen and nitrogen containing a larger percentage of oxygen than ordinary air should have the same effect on the luminosity of the flame as air, but this is disproved by the following results:—

Volumes of Varying Mixtures of Oxygen and Nitrogen required to render 1 volume of Coal-gas Non-luminous in a Bunsen burner.

Gas.	Vol. of Mixture required.	Composition of Mixture.		Vol. of Oxygen present in amount required.
		Nitrogen.	Oxygen.	
Vol. 1	2·30	1	nil.	nil.
1	2·30	5	1	0·38
1	2·27	4	1	0·45
1	2·02	3	1	0·50
1	1·49	2	1	0·50
1	1·0	1	1	0·50
1	0·50	nil.	1	0·50

From this it will be seen that until the percentage of oxygen reaches the amount present in air, the diluting influence of the nitrogen overpowers the effect of the oxygen in the destruction of the luminosity, but with 25 per cent. and over of oxygen the retarding influence of the nitrogen has no effect on the activity of the oxygen.

The effect of various gases in bringing about non-luminosity was then tried, but the employment of a wet meter for measuring purposes rendered the number of these limited.

Volume of Gases required to render One Volume of Coal-gas Non-luminous.

1 vol. coal-gas requires 0·50 vol. of oxygen.
,, ,, 1·26 ,, carbon dioxide.
,, ,, 2·27 ,, air.
,, ,, 2·30 ,, nitrogen.
,, ,, 5·11 ,, carbon monoxide.
,, ,, 12 40 ,, hydrogen.

So that a combustible diluent which increases the temperature of the flame is required in far larger quantity than a non-combustible diluent in order to render the flame non-luminous.

The varying effects of diluents have been attributed to the influence of density, but it has been shown by Heumann that a flame can be rendered non-luminous by cooling as well as by dilution. If a luminous flame be caused to spread itself over a cold surface it became non-luminous, but the luminosity could be restored by heating the surface over which the flame plays. If therefore a diluent had the power of extracting more heat from a flame than another it would be more active in reducing the luminosity, so that a smaller quantity would be required to render the flame non-luminous, and on comparing the specific heats of the gases used in the last experiment the reason for the small quantity of carbon dioxide is at once seen.

Specific Heats of Equal Volumes.

Oxygen	0·2405
Carbon dioxide	0·3307
Nitrogen	0·2370
Air	0·2374
Carbon monoxide	0·2370
Hydrogen	0·2359

Experiments show that this is in all probability the true explanation, as in the flames rendered non-luminous by diluents, the inner cone for the first $1\frac{1}{2}$ inch is decidedly cooler than in the luminous flame, owing to the cooling action of the nitrogen or carbon dioxide. Above this point, however, the influence of the oxygen begins to be felt, and the non-luminous flame is here hotter than the luminous flame, whilst the hottest portion of the flame is to be found half way between the tip of the inner and outer cones. With inert diluents, however, the hottest points are found at the side and tip of the outer cone when the air necessary for the combustion is obtained.

With a Bunsen burner, in which the mixed gas and air give a green inner cone, although a low temperature, due to the excess of air, is found at the bottom of the inner cone, yet the increased quantity of oxygen causes a rapid oxidation in the upper portion and a smaller and hotter flame is produced.

From these experiments and also from the researches of Heumann it will be seen that several causes aid in the destruction of luminosity in a flame, chief amongst which are oxidation, dilution, and cooling.

The chemical changes taking place in a Bunsen flame are far more simple than those which are going on in the luminous flame. Taking the ordinary London coal-gas having the composition :—

Hydrogen	52·16
Unsaturated hydrocarbons	3·50
Saturated hydrocarbons	36·25
Carbon monoxide	3·68
Carbon dioxide	0·00
Nitrogen	4·10
Oxygen	0·31
Sulphuretted hydrogen	0·00
	100·00

We find that a gas of this composition requires about 5·0 times its own volume of air for its complete combustion. When a Bunsen burner burns with a blue non-luminous flame, the ratio of gas to air is about 2 to 1, less than half the amount necessary to complete combustion, whilst with the green inner cone 2·5 of air mix with 1 of gas, so that the Bunsen flame obtains from the mixture only about one-half the air necessary for its complete combustion, the remaining portion being obtained from the exterior of the flame during combustion. This is the cause of the double cone in the flame, the inner cone being formed by the incomplete combustion of the gas with the admixed air, and the outer cone by the combustion of the products of this incomplete combustion by means of the external air. This can be proved by the use of an apparatus devised by Mr. Lewis T. Wright and perfected by Professor Smithells, in which the two parts of the flame can be separated. This dual action is practically complete when the ratio of air to gas is 2·6 to 1 and the green cone is produced, and the action of the mixture in the inner cone may be approximately expressed by the following equations :—

$$\underset{\text{Hydrogen.}}{H_2} + \underset{\text{Oxygen.}}{O} = \underset{\text{Water.}}{H_2O}$$

$$\underset{\text{Ethylene.}}{C_2H_4} + \underset{\text{Oxygen.}}{O_3} = \underset{\text{Carbon monoxide.}}{2\,CO} + \underset{\text{Water.}}{H_2O} + \underset{\text{Hydrogen.}}{H_2}$$

$$\underset{\text{Methane.}}{CH_4} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Carbon monoxide.}}{CO} + \underset{\text{Water.}}{H_2O} + \underset{\text{Hydrogen.}}{H_2}$$

The resulting carbon monoxide and hydrogen in about equal proportions diluted with twice the quantity of steam and the unchanged nitrogen burn at the expense of the oxygen of the external air forming the outer cone. A small quantity of carbon dioxide is also always found, probably due to the oxidation of some of the carbon monoxide by the steam, and the gaseous mixture which forms the outer cone has an approximate composition of—

	Per cent.
Water Vapour	16
Nitrogen	60
Carbon Monoxide	9
Hydrogen	10
Carbon Dioxide	5
	100

It does not seem possible that such a mixture, containing as it does less than 20 per cent. of combustible gas, should burn and produce the intense heat found in the outer cone of the Bunsen burner, but Professor Smithells has shown that under ordinary conditions the heat of the inner cone is added to that of the outer, so that in the combustion the outer cone is always hotter than the inner.

That this is so can be clearly shown by using the Smithell tube, and having widely separated the two cones of the flame, holding a mantle in the outer zone. The mantle is not then heated to incandescence, but on now allowing the inner cone to rise in the tube, the mantle becomes more and more luminous until the zone has resumed its proper position in the centre of the flame, when the mantle gives its full incandescence.

It is quite clear that the ratio of gas to air needed to give the best results in a Bunsen burner intended for use with an incandescent mantle must be the one which yields the hottest outer zone to the flame, and it might be expected that this would be arrived at by only just allowing sufficient air to mingle with the gas to render it non-luminous, as there is then a larger proportion of combustible gas to burn at the surface of the mantle, and one might expect a higher temperature at that point. This, however, is not the case, as the heat from the combustion in the inner zone can only escape through the outer zone, and the maximum effect on the mantle is produced when, as nearly as possible, one half the combustion takes place in the inner zone at the expense of the air drawn in with the gas through the air-holes of the Bunsen, whilst the second half is burnt on the surface of the mantle itself.

This was proved experimentally by closing the air-holes, removing the injector from a mantle burner, and fitting in its place a T-piece, through the arms of which the gas and air measured by the standard meters were passed. The gas supply was kept constant at 5 cubic feet per hour at a pressure of 1·5 inches of water, and the air regulated to give the desired appearance to the flame. The rate of flow of gas and air was then taken, and a well-fitting mantle placed on the flame, the illuminating power ascertained, and a Le Chatelier thermo-couple placed so that the twist just touched the mantle at a point one inch above the burner head. Every precaution was taken to ensure accuracy, and the results were as follows :—

Condition of flame.	Ratio of flow.		Ratio.		Candle Power per c. ft. of gas.	Temperature o°C.
	Gas.	Air.	Gas.	Air.		
Under aerated ...	4·5	10·0	1	2·2	14·4	1880
Best aeration ...	4·5	12·75	1	2·75	20·0	1915
Over aeration ...	4·5	15·25	1	3·4	17·7	1905

On analysis the gas was found to contain :—

Hydrogen	60·4
Saturated Hydrocarbons	28·1
Unsaturated Hydrocarbons	4·0
Carbon Monoxide	5·0
Carbon Dioxide	0·0
Oxygen	0·5
Nitrogen	2·0
	100·0

And by exploding with oxygen it was found that for its complete combustion one volume of gas requires 5·5 volumes of air.

From this experiment it is clear that there is a point in the aëration of the Bunsen flame which gives the highest temperature in that portion in which the mantle is situated, and that above or below this ratio the light yielded by the mantle suffers.

Experiments were then made to determine the effect upon the light emitted by the mantle of different degrees of aëration, the arrangement of the apparatus being such that the burner could suck in the air it needed in the usual way from a tubulated globe, the gas being burnt at a constant rate under a pressure of 1·5 inches of water, whilst the flow of air could be varied. The result shows that with a 16 candle gas, on increasing the aëration, the candle power of the mantle steadily rises until a maximum is obtained with a little more than one-half the amount of air required for complete combustion, whilst on increasing the aëration above this point, the candle power steadily fell.

A serious trouble with mantle lighting is the carbonisation of the mantle, which commences with a slight sooty deposit at one spot, and then rapidly grows over the surface of the mantle, not only reducing the light emitted

but giving rise to traces of carbon monoxide in the products of combustion.

When the flame is under-aërated and contains a ratio of less than 2·2 volumes of air to 1 of gas, some methane escapes combustion in the inner zone of the flame and burns with the carbon monoxide and hydrogen in the outer flame, and it is this which causes the trouble.

On replacing the ordinary tube of a Bunsen burner with one made of platinum, and if the ratio of gas and air be so arranged as to give a blue non-luminous flame, on heating the platinum tube the flame becomes luminous, although not to such an extent as would have been obtained from the original gas. If the tube be allowed to cool down the flame again becomes non-luminous, showing that the luminosity is due to the restoration of heat to the flame and not to any alteration in the composition of the gas. But with a Bunsen burning with a green inner cone, luminosity cannot be produced by heating the mixture of gas and air. On now taking an ordinary Bunsen with a brass tube and surrounding the blue non-luminous flame with a platinum gauze mantle open at the top, and so arranged that the sides of the flame heat the mantle to a high temperature, the top of the flame will become luminous, owing to the platinum superheating the flame gases from the inner cone and causing them to decompose with separation of particles of carbon. The same result is obtained with an ordinary mantle open at the top, and it is to this cause that the deposition of carbon on the mantles is due.

It will often be found that the carbon begins to deposit on the rod which supports the mantle, and is fixed in a small plate in the burner head. Above this plate there is a zone of unburnt gas which is raised to a high temperature by the radiant heat from the walls of the mantle, and the same conditions as before for the deposition of carbon are brought about. When once this carbon has started to form, its catalytic action causes the decomposition of the hydrocarbons still present to proceed with greater rapidity, so that in time both the upper part of the rod and the mantle become so crusted with carbon as not only to reduce the light emitted to a minimum, but to cause the formation of distinct quantities of carbon monoxide in the products of combuston.

The amount of air needed to give a non-luminous Bunsen flame varies with the richness in hydrocarbons of the gas, and the higher the candle power the greater must be the volume of air used for each volume of gas. It is found by experiment that although the increment in the volume of air needed for each extra candle-power in the value of the gas is fairly constant for gases below 20 candle-power, it rapidly rises when richer gases are used. The candle-power of the original gas also affects the light which is to be obtained from the mantle.

If an ordinary burner and mantle be purchased, and tested first with 16-candle gas then with 15, and finally with 14-candle-power gas, it is often found that it gives a better light with the 15 than the 16, and a further improvement with the 14-candle gas. This, however, is dependent upon the fact that the burner is drawing in less than the necessary amount of air to give the best conditions of combustion in the inner zone, and that the right degree of aëration is being more and more nearly approached with the poorer gas. When care is taken to ensure the correct ratio of air and gas consumed in each case, it is found that for qualities of gas between 14 and 18 candle-power there is a gain of about 3 per cent. in the light emitted by the mantle for each candle illuminating power in the gas.

When Welsbach first introduced the incandescent mantle, the burner which he used consisted of a small Bunsen burner of the ordinary type, with a tube of about the same length as in an ordinary laboratory Bunsen, on to which was fitted a gallery to carry a chimney and a head stamped out of thin sheet-metal. The length of the fitting was, however, objected to by consumers, who had up to that time only been accustomed to screwing a flat flame or Argand nipple on to their fittings, so the burner tube was very soon shortened, and the head carrying the gallery which fitted over it was made so that it slightly increased this length.

Many forms of these burners have been used, the differences being chiefly dependent upon the construction of the head, some consisting of open circular slots, others of flat gauze discs with a small baffle in the centre, some having gauze domes, others steatite or cut metal tops. But owing to the construction of the burner, they all had one peculiarity, and that was they under-aërated the gas before combustion, and, in consequence, a chimney was required with them in order to create an up-draught, and to bring air rapidly in contact with the burning gas on the surface of the mantle.

When no chimney was used the unburnt gas from the inner zone had to travel a small distance from the surface of the mantle, through which it was passing before it obtained the necessary air for its combustion, hence the layer of highest temperature was outside the mantle, which, in consequence, was not raised to the highest degree of incandescence; but when the chimney was put on the uprush of air that it created burnt the escaping gas on the surface of the mantle itself, and the best results were obtained. Burners of this class are still those most used, and it is now fully realised that if the amount of air sucked in by the burner is not at least one-half the total volume of air needed for the complete combustion of the gas, a chimney of such length as to create a sufficient draught to consume all surplus gas on the surface of the mantle must be used. Taking a 14 or 15 candle-power gas, a 6-inch chimney is generally sufficient to supply the necessary air, whilst with a rich gas, such as is supplied in Edinburgh, a 10 or 12-inch chimney is not too long for the work it has to do.

It is now beginning to be found that the chimney even is capable of improvement, and that if instead of allowing all the air to be drawn up from the bottom, holes are made in the chimney just above the level of the burner head, the air impinges more directly on the mantle and a slightly better result is attained. The idea, originally due to Sir Edward Frankland and revived every few years since, of heating the air supply by making it pass down between an outer glass and the chimney before ascending the interior of the chimney itself has also been applied to mantle burners, but unless very carefully adjusted, the loss of light due to absorption by the glasses nearly makes up for the slight gain.

Mantle burners in which regeneration has been attempted have also been tried, but the fact that the air or gas can be heated separately, and then utilised to give a very hot flame, does not apply to the mixture of the two, as when a mixture of air and gas is heated, oxidation of the gas commences, and the loss of combustible matter due to this cause outweighs the advantages of pre-heating.

Real improvements in the burners employed in mantle heating commenced in the early nineties, and at this period Chemin and Bandsept both began working at the idea of adding air to the gas in small portions so as to gain a more intimate mixture of the two before combustion. Chemin's burner however was never a practical success, but Bandsept succeeded in producing a burner which up to the present time has never been excelled. Using a conical injector of such a character as to spread the jet of gas issuing from it, he placed above it a short truncated cone which upwardly converged in such a way that the area of the upward flow of the jet of gas practically filled it; above this again he placed another cone of the same character having a still wider opening at the top. Several of these ever-widening cones being used and a suction being created in each, air was allowed to be drawn in through small holes in the base of the cones, and mingling with the upwardly flowing stream of gas and air entered a larger upwardly diverging cone which acted as an expansion cone and relieved the pressure that otherwise would have been created by expansion on nearing the heated burner head. The gases were finally mixed by passing through atomisers consisting of double layers of wire gauze, perforated metal thimbles, or other devices, which would complete the admixture of the air and gas immediately before combustion.

The work done by Bandsept in perfecting the Bunsen for mantle heating was enormous, and on glancing back through his Belgian patents one finds that nearly every feature of such modern burners as the Kern had been worked out by him before 1896. His burners are still the best that have been introduced and are indeed the form of chimneyless burner adopted by the French Auer Company.

In 1894 De Mare made a number of different forms of burner for his plumes and for mantles, and improved the suction given by his jet of coal-gas, by placing above it a tube having the form of two cones united at their summits. This largely increased the uprush of the mixture and also added slightly to the amount of air drawn in with the gas. The so-called "Simplex" burners, which are now largely used, are made upon the principles enunciated by De Mare in his patent.

In the burners made upon the principles first put forward by Bandsept and De Mare, owing to the superior rigidity of the flame due to the increased rate of outflow of the mixture and the aëration being brought up to the best point for exciting the incandescence of the mantle, the chimney can be dispensed with.

Perhaps the best known chimneyless burner at the present time is the highly vaunted Kern burner, in which the form of head devised by Bandsept in one of his earliest patents is added

to the suction tube formed of truncated cones patented by De Mare, giving a burner which yields practically the same photometric results.

It must always be remembered that the statements of illuminating power yielded by various incandescent mantles and burners is always open to the interference of several important factors, the chief one amongst which is fit of the mantle. Most observers seem to imagine that so long as the mantle will go over the burner head, and the rod that supports it is of the prescribed height, the full illuminatiug power which the burner and mantle are capable of yielding is given. This, however, is an entire mistake, as unless the mantle not only fits the head, but also the flame perfectly, serious discrepancies at once arise; and although when a perfectly-fitting mantle is obtained such chimneyless burners as I have described will give as high as 24 candles per cubic foot of gas consumed, they are just as often found to give 14, and if the burners and mantles commercially sold be taken and tested carefully, the average comes out at about 18 or 19 candles per cubic foot of gas. Until absolute uniformity in the construction of the burner and in the shape of the mantle can be obtained these discrepancies cannot be avoided, and it is only by taking the greatest possible precautions that fair results can be obtained.

I cannot help thinking that manufacturers make a great mistake in claiming illuminating powers for their mantles and burners which have only been obtained in isolated cases where by chance perfect conditions have been attained, as the non-fulfilment of these results in practice gives rise to disappointment to the consumer, and discredits the particular form of burner.

In conclusion, I can only regret that the shortness of the course has prevented me from dealing with a large number of points which otherwise I would have liked to touch upon.

Miscellaneous.

AUSTRALIAN COAL.

Coal deposits exist in all the Australian colonies, the largest being in New South Wales, and the smallest in South Australia. In the former colony, according to Mr. Coghlan, the Government Statistician, the carboniferous formations extend over a considerable portion of its area, and workable coal seams have been discovered in many places. At present, however, the coal-mining industry is confined to those centres which, from their close proximity to ports of shipment or the railway lines, afford ready means for the disposal of the commodity when raised. Coal was first discovered in the colony in 1797 near Mount Keira, in the Illawarra district, by a man named Clark, super-cargo of the Sydney Cove, while he was endeavouring to reach Sydney by way of the coast, after the wreck of that vessel in Bass Straits. Later in the same year Lieutenant Shortland discovered the river Hunter, with the coal-beds situated near its mouth, and mining operations in this district, begun in 1826, have reached large dimensions. The deposits have been found in the Blue Mountains, near the line of railway which runs along their crest, at Katoomba, Lithgow, Wallerawang, and elsewhere now supply a portion of the requirements of Sydney and other industrial centres in its neighbourhood, as well as part of the western district of the colony. Coal is also mined at Berrima and other places in that locality, whence a large quantity of the coal consumed in the southern districts of the colony is obtained. The area over which coal is distributed is very great, and has been computed at 23,950 square miles; besides this, it is known to underlie the Hawkesley sandstone in and around Sydney. Shafts are being sunk on the shores of Sydney Harbour to work a seam of coal, over ten feet in thickness, the existence of which was ascertained by a bore at a depth of 2,929 feet. A seam, 6 feet 6½ inches thick, has been found on the Moorbank Estate, near Liverpool, at a depth of 2,583 feet. Coal has also been found in the Clarence series, though it has not yet been worked commercially. Three seams have been proved at Coraki, on the Richmond river. Several parties have exploited this district for coal, and at the mine at Aberdare 150 tons of good coal have been obtained from a seam six feet thick. The quantity of coal in the coal measures down to a depth of 4,000 feet, and excluding seams less than 30 inches, is estimated by the Government Geologist at 78,198 million tons. This estimate allows one-third loss in working. In 1826 the Australian Agricultural Society obtained a grant of 1,000,000 acres of land, together with the sole right, conferred by charter, of working the coal-seams which were known to exist in the Newcastle district. Several mines were opened up and profitably worked for a number of years; but it was not until the expiration, in 1847, of the monopoly enjoyed by the company that the coal-mining industry showed signs of extensive development. During the year named the output of coal only reached the total of 40,732 tons, of the value of £13,750. Six years afterwards the production had become doubled, and the output of the mineral has rapidly increased year by year until coal mining is now one of the staple industries of the colony, the production for the year 1899 amounting to 4,597,028 tons, valued at £1,325,799. In 1898 the quantity was 4,706,251 tons, value £1,271,832, the price of coal having since advanced. The total production to

the close of 1899 was 85,969,136 tons, representing a value of £35,647,004. The quantity of coal exported during 1899 was 2,798,523 tons, value £1,005,794; the places outside the Australian colonies to which shipments were made being Ceylon, Fiji, Hong Kong, India, Mauritius, New Guinea, Straits Settlements, Celebes, Chili, China, Cochin China, Ecuador, Hawaii, Japan, Java, Marshall Islands, Mexico, Molucca Islands, Mozambique, New Britain, New Caledonia, Panama, Peru, The Philippines, South Sea Islands, and America. A few hundred tons were also shipped to Great Britain. The output for 1900 is expected to be the largest on record. Newcastle, the centre of the coal trade, is singularly well fitted by situation to become the port of supply for all the countries of the southern seas. At the present time it is crowded with vessels waiting to secure coal supplies, especially for the East. Every provision has been made by the New South Wales Government for shipping coal, and over two miles of wharves, furnished with cranes and shoots capable of loading over 28,000 tons per day, line its shores. The markets of the colonies are likewise supplied with quantities of excellent coal from the seams worked in the Illawarra district, and the product of the southern collieries is also exported in large quantities, especially the smokeless coal, which is much used by the war vessels on the Australasian station.

MANUAL TRAINING IN GERMANY.

On the 1st October last, twenty-four years had elapsed since the movement having for its object the manual training of boys was inaugurated in Germany. In this space of time the idea has certainly been disseminated largely in the country, and over two thousand teachers have given their co-operation to the movement; nevertheless, says the United States Consul at Glauchau, both the internal and external conditions connected with this new branch of tuition leave much to be desired. The original training in home industries and home occupation has almost entirely disappreared; it is carried on at present only in a few places in Holstein and in 17 institutes for the blind. Most of the other educational establishments in Germany, including 18 orphanages and 46 deaf and dumb institutes, have already introduced manual training into their curriculum. The endeavour, however, to prepare the pupils in the schools directly for the eventual handicraft has obtained importance in only two of Germany's institutions of learning. The majority of the German home-industry schools only deal pedagogically with the subject. There exist at present in Germany, distributed in 605 places, 861 schools and institutes wherein manual training is carried on in 1,514 workshops. Of this number 836 schools and institutes conduct the training on a pedagogical basis. Prussia has 570 manual-training schools spread over 435 places and distributed among 596 workshops. Industrial centres take the lead as follows:—Prussia, Upper Silesia, the Rhenish province, and the Kingdom of Saxony. The 1,514 pupils' workshops comprise 286 independent manual training schools, and 238 public schools, of which 16 are auxiliary schools, where the work is obligatory; 17 middle-class schools, 41 high schools—made up of 8 gymnasiums, 12 technical and technical high schools, and 15 boarding-schools — 7 preparatory institutes, 26 teachers' seminaries, and 93 boys' asylums, while the remainder is made up of various kinds of private educational establishments. The organisation of the handicraft tuition in the individual schools and institutes is varied in character. Sixty-nine institutes have adopted the whole curriculum as recommended by the German Association for the Dissemination of Manual Skill, while 16 dispense with the preparatory work; of the rest, 177 schools and institutes confine themselves to three branches, 261 limit themselves to two, and the remainder to one branch only. Five hundred and thirty-five workshops are devoted to wood-carving, 527 to working in cardboard, and 336 to the carpenter's bench; of these, 68 are closely connected with wood-carving, 77 with preparatory roughing out work, 35 with metal work, 11 with turnery, and 11 with modelling in clay. Pedagogical manual tuition has branched out in three directions; the practical formal method, which regards handicrafts as a means to general culture; the direction advocated by those who aim at the so-called school manual dexterity; and the system which would make the manual training serve as the basis of individual branches of teaching, and utilise these in order to influence the method of instruction in schools. The first two are becoming more and more amalgamated. In the third direction, Professor Kumpa, at Darmstadt, School-Inspector Scherer, at Worms, and Herr Brückmann, at Königsberg, are at present engaged in making thorough experiments in public schools. The participation of German teachers in the efforts of the German Association is steadily increasing. Over 2,200 German teachers have up to now been taught to become instructors in manual training. Of these, 950 were taught in Leipzig, and 1,250 acquired training in thirty-three places in other parts of Germany.

INDIGO CROP OF INDIA.

Mr. Fremantle, officiating director of the Department of Land Records and Agriculture of the North-Western Provinces and Oudh, has presented his final forecast, dated September 26, of the indigo crop of 1900. It will be remembered that our Simla correspondent, in a telegram published in *The Times* of the 15th inst., reported that steps were being taken with a view to supplementing the cultivation of indigo with sugar. Mr. Fremantle says that the comparatively favourable rates obtained in the last year's sales encouraged sowings this year. The total area sown

with indigo has consequently risen to 271,396 acres, showing an increase of 39,996 acres, or 17 per cent. over the preceding year's area, which amounted to 231,400 acres. When compared with the average areas of the last five and ten years, the present year's area shows a drop of 25 and 18 per cent. respectively. Since last year a decrease of 5,742 acres took place in Farukhabad, of 1,639 acres in Muttra, and of less than 500 acres each in Saharunpur, Agra, Cawnpore, Allahabad, and Unao. The rest of the important indigo-growing districts show substantial increases. The condition of the crop, which in the last week of June was reported to vary from 75 to 90 per cent. of the normal, now stands at 62 to 87. The estimated yield of the present year's crop, worked out in the manner explained in the forecasts of the previous years, amounts to 47,293 factory maunds, as noted below, as compared with 26,966 maunds estimated last year, showing an increase of 20,327 maunds, or 75 per cent. The present year's yield is, however, 12 and 7 per cent. respectively below the average estimated yield of the past five and ten years:—Doab, 39,142 maunds; Benares, 8,151 maunds. The exports by rail to Calcutta in the period from October 1, 1899, to March 31, 1900, amount to 32,886 standard maunds, of which 28,641 maunds only went to Calcutta—nearly the whole of the rest being consigned to inland places. A similar deduction for the present year must therefore be made in calculating the amount of the dye which those provinces are likely to supply to Calcutta.—*The Times.*

MANUFACTURE OF MACARONI IN ITALY.

Macaroni is made of hard red wheat from the Black Sea, mixed with Italian wheat grown mainly in the plains round Foggia. This is ground into semolina—a very coarsely ground flour—the bran and husks are removed, and the semolina kneaded in hot water until it has the appearance and consistency of dough. The dough is then placed in a vertical brass cylinder, eight or nine inches in diameter, the bottom of which is a plate like the rose of a watering-pot, which is fine or thick, according to the macaroni required. Thus, for making vermicelli and all kinds of solid macaroni the holes are very small, while for making the tube macaroni the holes are much larger. In the latter case also a conical blade is fixed in the middle of the hole to form the tube. The dough being placed at the top of the cylinder, it is driven down by hydraulic pressure through the perforated plate and cut off by hand in lengths of about three feet. It is then hung on canes in the sun to dry. In the case of solid macaroni there is no difficulty in grasping the process. In the case of the tubular maccaroni the conical blade and its attachment cut through the dough, and the macaroni issues with a slit all along it. This, however, shrinks together at once and a perfect tube is formed, the join being practically invisible. Consul Neville Rolfe says that no macaroni is now made by the laborious hand process. There was for a long time a prejudice against machinery, but this has been overcome. The best macaroni is made at Grognano and Torre dell'Annunziata. A little also of the best quality is made at Amalfi, Alfonso Garofalo of Grognano being the most important manufacturer. Over 500,000 boxes are sent annually to the United States, and about 70,000 to London. The remainder is sold in Italy.

Correspondence.

UTILISATION OF BLAST-FURNACE GAS FOR POWER PURPOSES.

In order to remove a false impression that may have easily been created by Sir Charles Oppenheimer's consular report, I may perhaps be allowed to say that this Company, which owns the pioneer and master patents of Messrs. Thwaite and Gardner, is prepared to take action against any one in the country who employs purified and cooled blast-furnace gas for use in internal combustion engines.

It may interest Sir Charles Oppenheimer to know that, in this instance at least, British metallurgists and ironmasters have led the way.

WALTER BRAMALL,
Secretary, Blast Furnace Power Syndicate, Ltd.

7 to 11, Moorgate-street, E.C.
Oct. 30, 1900.

Obituary.

HOWARD HENRY ROOM.—By the death of Mr. H. H. Room, which occurred on the 26th ult., the Society of Arts loses an old and faithful servant. He was born in 1842. On both sides he came from a family of artists. His father, Henry Room, was an artist of some reputation, perhaps best known for his series of portraits in the *Evangelical Magazine.* His mother also had considerable artistic powers, and as Miss Louisa Derby obtained a silver Isis medal from the Society in 1828, for a pencil drawing of a landscape by Claude in the National Gallery. Her father, William Derby, the grandfather of Mr. Room, was a miniature painter, and was employed to make the drawings for Lodge's important work, "Portraits of Illustrious Persons."

Mr. Room entered the service of the Society in 1861 as a junior clerk. At that time Mr. Le Neve Foster was Secretary and Mr. Charles Critchett, Assistant-Secretary. On the retirement of the latter in 1869, there was a slight re-organisation of the office, and Mr. Room was appointed chief clerk. In 1875, Mr. S. T. Davenport, who had been for many years Financial

Officer of the Society, died, and Mr. Room succeeded him with the title of Accountant. The duties of this office he discharged with assiduous care and ability till the commencement, a few months since, of the illness which has now ended fatally. In addition to his work as accountant, he had the charge of the Society's Examinations, a duty affording full scope for the minute accuracy and painstaking care which characterised all his work.

His unfailing courtesy and natural kindliness caused him to be much liked by those of the members with whom he was brought in contact, and the nature of his duties caused him to be well known to many of them. His considerable powers of organisation, his steady devotion to work, and his unswerving rectitude of purpose, gained him the respect and the regard of those under and with whom he worked, while his amiable and kindly nature secured their affection.

As his life was devoted to the service of the Society of Arts, it was in other respects uneventful. He was a zealous Freemason, and took an active part in the working of the Order, holding for some years the important office of Secretary to the Province of Middlesex. He was extremely popular among the numerous members of the craft living in that county, and was held by them in very high estimation.

General Notes.

New Method of Bleaching. — The United States Consul at Coburg calls attention, in a recent report to his Government, to Professor Koechlin's method for the bleaching of cotton and other vegetable fibres by passing them through a bath of 100 litres (26 gallons) of water, 10 kilogrammes (22 lbs.) of lime, and 50 kilogrammes (110 lbs.) of bisulphite of soda. They are then steamed for an hour or two under a pressure of from one to two atmospheres, rinsed again and dried. The bisulphite can be replaced by hydrosulphite of lime. The cotton or other fibre may be boiled in the bath for a few hours instead of being steamed. Another process is to subject the goods for six hours under a pressure of two-thirds of an atmosphere to a liquid composed of 1,000 litres (264 gallons) of water, 10 kilogrammes of dry, caustic soda; 10 kilogrammes of soap, 1 kilogramme (2·2 lbs.) of calcined magnesia, and 30 litres (7·9 gallons) of peroxide of hydrogen; the goods are then rinsed, soused, rinsed again and dried. The white obtained is said to be much better than could be had with hypochlorite, and the process is stated to do no damage to the fibres or fabric.

Ancient Chariots.—A work on the chariots and vehicles of the Greeks and Romans, by Johann Christian Guizrot, Royal Inspector of Carriage Building and other ancient peoples in Bavaria, was published at Munich in 1817. It contains accounts of the early road making, and subsequent service for conveying the postal despatches in the Roman Empire, at first by horsemen, and afterwards in vehicles, also the use of vehicles accompanying an army, and of machines of war for use in sieges, and of vehicles used in triumphal processions also at funerals and public games. It is illustrated with many plates of vehicles copied from sculpture, such as the well-known column of Trajan, and from wall paintings and coins. A translation of this work, accompanied by the illustrations of the Munich volumes, some original and some copied, has been edited by Mr. G. A. Thrupp, and a type-written copy of this work in three volumes (quarto) has been lent to the Society by Mr. Thrupp, which can be seen by members in the library.

Coachbuilding Prizes. — The Company of Coach Makers and Coach-Harness Makers of London offer the following prizes for competition among British subjects engaged in the trades of Coach Making and Coach-Harness Making and members of drawing and technical classes in connection with such trades, resident in the United Kingdom of Great Britain or Ireland:—Competition No. 1—Prizes are offered to apprentices and others under 21 years of age, not attending day classes, for working drawings of a curved or angular Victoria body, framing, and joints; on two sheets; scale two inches to the foot; 1st prize, the Company's bronze medal and £3; 2nd prize, £2. No. 2—Open to members of evening drawing and technical classes and others (not attending day classes, each competitor to send three drawings of the side elevation of (1) a single brougham, (2) a dog cart phaeton (both vehicles on elliptic springs), (3) a gig, on two or four springs; scale one inch to the foot; 1st prize £4 4s.; 2nd prize £2 2s.; 3rd prize £1 1s. No. 3—Open to competitors, under the age of 25 years, attending evening drawing and and technical classes, for perspective designs of a curved or angular sociable; scale one inch to the foot; 1st prize £3 3s.; 2nd prize £2 2s.; 3rd prize £1 1s. No. 4—Open to all, for working drawings of an improved military ambulance on four wheels; scale four inches to the foot; 1st prize, the Company's silver medal and £6; 2nd prize, the Company's bronze medal and £4; 3rd prize, £3. No. 5—Open to managers, foremen, clerks, and others; the Master, Lt.-Col. Francis Joseph Stohwasser, offers £10 10s. to be divided as follows, for essays on the proper management of the body-making department of a carriage building business, in relation to plans, materials, labour and cost, describing the materials used and illustrated by sketches; 1st prize, £5 5s.; 2nd prize, £3 3s.; 3rd prize £2 2s. Drawings and essays to be delivered free at the Hall of the Company, Noble-street, St. Martin's-le-Grand, London, on or before the 31st day of March, 1901.

Correction.—Page 840, col. 2, "Indigo in West India," line 9, *for* 10 lbs. and 15 lbs. *read* 10 maunds and 15 maunds.

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FRIDAY, NOVEMBER 9, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-Hundred-and-Forty-Seventh Session will be held on Wednesday evening, the 21st of November, when an Address by SIR JOHN EVANS, K.C.B., F.R.S., Vice-President and Chairman of the Council, will be delivered.

Previous to Christmas there will be Four Ordinary Meetings in addition to the Opening Meeting. The following arrangements have been made :—

NOVEMBER 21.—Opening Address of SIR JOHN EVANS, K.C.B., F.R.S., Chairman of Council.

NOVEMBER 28.—" Malaria and Mosquitoes." By MAJOR RONALD ROSS. PROF. E. RAY LANCASTER, LL.D., F.R.S., will preside.

DECEMBER 5.—" Road Traction." By PROF. H. S. HELE-SHAW, LL.D., F.R.S. SIR ALEXANDER BINNIE will preside.

DECEMBER 12.—" The Treatment of London Sewage." By PROF. FRANK CLOWES, D.Sc.

DECEMBER 19.—" The Siege of Ladysmith." By W. T. MAUD (special artist to the *Graphic*).

Papers for meetings after Christmas :—

" Recent Inventions in Weaving Machinery." By PROF. ROBERTS BEAUMONT.

" Multicolour Printing." By ELMER Z. TAYLOR.

" The Synthesis of Indigo." By PROF. RAPHAEL MELDOLA, F.R.S.,

" School Work in Relation to Business." By SIR JOSHUA FITCH, LL.D.

" Evolution of Form in English Silver Plate." By PERCY T. MACQUOID.

" Clocks, Carillons, and Bells." By A. A. JOHNSTON.

" The Proposed High-Speed Electrical 'Monorail' between Liverpool and Manchester." By F. B. BEHR.

" Photography of Natural Colours by the McDonough-Joly Process." By H. SNOWDEN WARD.

" The Outlook for the World's Timber Supply." By DR. W. SCHLICH.

" Patent Law Reform." By ALEXANDER SIEMENS.

" Modern Artillery." By LIEUTENANT ARTHUR TREVOR DAWSON, late R.N.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons, at 4.30 o'clock :—

January 17, February 14, 28, March 12, April 16, May 16.

COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons, at 4.30 o'clock :—

January 22, February 19, March 19, April 30.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday evenings, at 8 o'clock :—

January 29, February 12, 26, March 12, April 16, May 21.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday evenings, at 8 o'clock :—

PROF. JOHN A. FLEMING, M,A., D.Sc., F.R.S., " Electric Oscillations and Electric Waves." Four Lectures.

LECTURE I.—NOVEMBER 26.

Electric Oscillations. — 1. Influence of frequency upon alternating current phenomena. 2. The effects due to inductance and capacity predominate with increased frequency. 3. An electrical oscillation defined as an alternating current of very high frequency. 4. The production of electrical oscillations by condenser discharges. 5. Presence of both capacity and inductance a necessary condition for the establishment of electrical oscillations. 6. Dissipative action of resistance. 7. The two varieties of condenser discharge. 8. Theoretical predictions of Henry, von Helmholtz, and Kelvin. 9. Experimental confirmation by Paalzow, Feddersen, Blaserna, and others. 10. Photographs of Leyden jar discharges by Boys, Trowbridge, and others. 11. Experimental arrangements for producing electrical oscillations. 12. Experimental proofs of oscillatory condition of discharge, mechanical illustrations. 13. Necessity for a sudden release of some constraint to secure oscillations. 14. Peculiar properties of air as a dielectric. 15. Its sudden passage into a conductive condition. 16. Dielectric strength. 17. Sparks in oil. 18. The production of secondary oscillations. 19.

Transformation of oscillations. 20. Induced oscillatory discharges in gases. 21. Peculiar properties of very rapid alternating currents. 22. Effects of magnetic screening exceedingly marked; explanation of screening. 23. Propagation of magnetic flux through conductors. 24. Electrical resistance to passage of high frequency alternating currents. 25. Skin effect. 26. Immense influence of inductance in arresting electrical oscillations. 27. Effects due to permeability of surrounding medium. 28. Magnetisation of iron by oscillatory currents. 29. Proof that the magnetic properties of iron are still influential even when the magnetising force is due to electrical oscillations. 30. Summary of the distinctive qualities of electrical oscillations.

Lecture II.—December 3.

Electric Resonance.—1. The free period of oscillation of an electric system. 2. Free and forced vibrations. 3. Mechanical illustrations. 4. The electrical vibration period of a sphere. 5. Damped and persistent oscillations. 6. Good and bad electrical radiators. 7. Damping due to radiation as well as resistance. 8. Bjerknes' and Poincaré's views. 9. The vibrations of a dumb-bell radiator. 10. Electrical resonance. 11. Resonance effects in the case of low frequency alternating currents. 12. Electrical tuning or sympathetic resonance. 13. Experimental illustrations of tuned circuits. 14. Influence of damping upon electrical resonance. 15. Conditions to secure resonance when acoustic or electric. 16. Rate of radiation from dumb-bell radiator. 17. Logarithmic decrement of radiating circuit. 18. Arrangement foı producing electrical oscillations of great energy and persistence. 19. Various devices for producing an oscillatory discharge by means of condensers and transformers. 20. Experiments with tuned electric circuits. 21. Stationary electric oscillations set up in long wires. 22. Selective absorption. 23. Electric resonance presented as a phenomenon in optics in absorbing media.

Lecture III.—December 10.

The Electromagnetic Medium.—1. The hypothesis of an electromagnetic medium. 2. Maxwell's application of Lagrange's dynamical methods to the treatment of electrical problems. 3. The dynamical equivalents of electrical and magnetic quantities; their interlinking and relations. 4. The two systems of electrical units. 5. Measurement of electric and magnetic quantities in electrostatic and electromagnetic units. 6. Experimental measurement of the unitation ratio "v." 7. The physical meaning of "v." The velocity of propagation of an electrical displacement or magnetic flux. 8. The two fundamental constants of the electromagnetic medium or other dielectric; their essential interdependence. 9. Their connection with the optical refractive index. 10. Maxwell's law connecting dielectric andoptical constants. 11. The measurement of dielectric constants by various experimental methods. 12. Maxwell's law fulfilled in the case of liquid oxygen and other substances. 13. The numerous exceptions to Maxwell's law. 14. Effects of increased frequency and temperature on dielectric constants. 15. Low temperature measurements of dielectric constants. 16. Dielectric constants under low and high frequency for water, alcohol, glass, and other bodies. 17. Mechanical illustrations. 18. Predeterminations of dielectric constants. 19. Maxwell's law. 20. The analogy between electric and mechanical stress and their relations. 21. Transference of electromagnetic energy through space. 22. Theories of the æther. 23. Is a mechanical theory of the æther a sufficient hypothesis? 24. Arguments in favour of the view that the optical and electromagnetic æther are identical. 25. The atomic or electronic theory of electricity. 26. Æther, electricity, and matter.

Lecture IV.—December 17.

Electric Waves.—1. The characteristics of true wave motion. 2. Conveyance of energy through a medium by wave motion. 3. The necessary qualities of the undulating medium. 4. Various types of waves—surface, compressional, distortional waves. 5. Electric or displacement waves in dielectrics. 6. Maxwell's conception of the propagation of electric displacement through space. 7. Hertz's investigations. 8. Hertz oscillator and resonator. 9. Hertz's production of stationary electric waves in dielectrics. 10. Mode of employing the resonator as a wave detector. 11. The velocity of electric waves in free space. 12. Bjerknes differentation of the actions in the radiator and resonator. 13. The discoveries of Sarasin and De la Rive on the function of the resonator. 14. Poincaré's and J. J. Thomson's explanations. 15. The velocity of propagation of electric waves along wires. 16. The arrangement of Hertz and Lecher. 17. Other electric wave detectors. 18. Experiments of Trowbridge and Duane on the velocity of transmission of electric waves along wires. 19. Methods of detecting the presence of electric waves. 20. Hughes' metallic microphone. 21. Branly's sensitive filings tube. 22. Lodge's coherer. 23. Improvements of Marconi in the construction of sensitive tubes. 24. Positive and negative electrovariable contacts. 25. Bose's investigations on sensitive metallic contacts. 26. Convenient form of radiator and receiver for experiments with electric waves. 27. Essential difference between the actions of the Hertz resonator and the sensitive imperfect contact or electro-variable conductor. 28. The reflection of electric waves. 29. The transparency of insulators and opacity of conductors to electric radiation. 30. Methods of producing electric radiation of small wave length. 31. Apparatus of Rhigi, Lebedew, and others. 32. Polarisation of electrical radiation. 33. The researches of FitzGerald and Trouton on the relations of the electric and magnetic vectors to the plane of polarisation. 34. The refraction of electric rays. 35. The electrical refractive index. 36. Determinations of Hertz, J. J. Thomson, Cole, Drude and others. 37. The differences between electrical and optical refractive index. 38. The effects of changing frequency. 39. Dielectric constant and electrical refractive index; investigations of Hopkinson, Blondlot, Perrott, Bose, Bouty and others. 40. The different retardation of electric and luminous æther waves in passing through transparent media or dielectrics. 41. The causes of this difference. 42. The interaction of matter molecules and æther waves. 43. Conclusion.

J. Liberty Tadd, "Elementary Art Education." Four Lectures.
January 14, 21, 28, February 4.

W. J. Pope, "The Bearings of Geometry on the Chemistry of Fermentation." Four Lectures.
February 11, 18, 25, March 4.

Major P. Cardew, "Electric Railways." Three Lectures.
March 11, 18, 25.

Sir William Chandler Roberts-Austen, K.C.B., F.R.S., "Alloys." Four Lectures.
April 22, 29, May 6, 13.

Juvenile Lectures.

Two Lectures, suitable for a Juvenile audience, will be delivered on Wednesday evenings, January 2 and 9, at half-past Four o'clock, by E. Walter Maunder, F.R.A.S., Superintendent of the Solar Department, Greenwich Observatory, on "Eclipses."

ARTHUR YOUNG AT THE SOCIETY OF ARTS.

The condition of Agriculture in England in the early part of the eighteenth century was not a satisfactory one, although great improvements had been made by many of the chief landowners of the country, and especially by the famous Jethro Tull, who died in 1741, the year in which Arthur Young was born. In 1723 the Society of Improvers of Agriculture in Scotland was instituted, and the Dublin Agricultural Society was started in 1749, but in England it was the Society of Arts (founded in 1754) which undertook the encouragement of agriculture. Two agricultural periodicals were established, one in 1764 (the *Museum Rusticum*), and the other in 1768 (Robert Dossie's *Memoirs of Agriculture*). Both of these publications were organs of the Society of Arts.

The *Museum Rusticum* is stated on the title-page to be "revised and digested by several members of the Society for the Encouragement of Arts, Manufactures and Commerce," and in the preface, after the dedication to the Society, the editor alludes to "those worthy patriots who preside over the whole, and to whom we are obliged for their constant and impartial attention to the improvers of agriculture and arts. Without their well-directed premiums many of the discoveries which we have transmitted to posterity would have been lost."

In the first volume of the *Museum* there is a letter (dated Jan. 16, 1764), in which the establishment of "Societies of Agriculture in the several connties of England" is strongly urged. This plea was not effective to any great extent, but in 1767 an Agricultural Society was established at Manchester. The Bath and West of England Society followed in 1777.

Arthur Young was a constant contributor to the *Museum*, and his first letter is signed "Y," and is dated from Bradfield, near Bury, October 2, 1764, when he was three-and-twenty years of age. The title is "Common Farmers Vindicated from the Charges of being universally ignorant and obstinate, with some Reflections on the present state of Improvements in Husbandry." The editor appended the following note:—"We are greatly obliged to this very sensible farmer for his favours, and hope to have frequent opportunities of communicating his sentiments to the public." (vol. 3, pp. 188-191).

On the advice of the Rev. Walter Harte, the tutor to Lord Chesterfield's natural son, Philip Stanhope, and the friend of Samuel Johnson, Young collected his scattered papers in the *Museum Rusticum*, and published them as an Appendix to *The Farmer's Letters to the People of England* (1767), under the title of "Sylvæ: or Occasional Tracts on Husbandry and Rural Economics." The last of these papers is entitled "Of the Usefulness of Acquiring a Knowledge of Foreign Practices in Husbandry, with some Hints towards attaining and propagating that Knowledge; particularly recommended to the notice of the Society instituted for the Encouragement of Arts, Manufactures, and Commerce."

The *Memoirs of Agriculture* was projected by Robert Dossie in 1768, with the main object of offering a better medium for the publication of the proceedings of the Society than was provided by the *Museum Rusticum.* Dossie in his dedication of the first volume to George III., and in his chapter on the Improvements in Agriculture pays a special tribute to the work of the Society as the main support of the improvers of agriculture at that time. The second volume is dedicated to Lord Romney, President of the Society, and the third volume to the Duke of Northumberland.

The mode of encouragement adopted by the Society was that of the offer of premiums, and in 1765 a prize of £5 was awarded to Arthur Young for having planted an acre of ground with madder. In 1767 Young was again awarded a similar prize for a renewal of his plantation of madder. In 1769 he received two gold medals, one for the rearing and fattening of hogs by a particular method, and the other for the cultivation of cole seed. In this same year, 1769, Young was elected a member of the Society, on May 17th.

Although the potato was introduced into England in 1585 by Sir Francis Drake, twenty years after John Hawkins brought it to Ireland, it did not for many years attract much attention. It was not planted in the open fields of England until 1684, and so little was it esteemed that in the "Complete Gardener," of London and Wise, published in 1719, no mention is made of it. The Society of Arts endeavoured to promote the extensive cultivation of potatoes, and in 1768-69 and 1772, John Howard, the philanthropist, communicated to the Society accounts of a new potato called the clustering or Bedfordshire potato. He presented a considerable quantity of the potatoes to the Society, and they were distributed among those desirous of cultivating them. In 1772, a gold medal was awarded to Howard for his culture of the clustered potato. Letters from Howard are in the possession of the Society, in which he promises to attend the Committee of Agriculture to give such further information as might be required.

Young mentions in his Autobiography (1771), that Howard sent him "a basket of his American potatoes, afterwards known as the Howard and cluster potatoes." At this time Howard had not taken up the work of his life in the improvement of the prisons and hospitals of the world. Young describes him as then quite unknown, and only famous for his introduction of this potato. Young visited him with Mr. Whitbread, and found him a singular character, "expressing himself in a manner that seemed to belong to two hundred years ago." He "was dressed as for an evening in London—a powdered bag wig, white silk stockings, thin shoes, and every other circumstance of his habiliments excluding the possibility of a country walk." Young

made good use of his basket of potatoes, for the minutes of the Committee on Agriculture contains the following entry: "The Secretary reported that Arthur Young, Esq., had offered to supply the Society with a hundred bushels of the clustered potatoes at three shillings per bushel. Resolved that Mr. Young's proposal be accepted, and that the Secretary do write to him accordingly." Seven years after this the Society awarded both a gold and a silver medal to Young "for an account of the culture, produce, and application of the Howard or Clustered Potato"—(*Transactions*, vol. 2, p. 7; vol. 3, p. 30).

In the Transactions for 1786 he contributed a continuation of his experiments on this potato, and to his paper is prefixed the following editorial note. "As the culture of potatoes is now acknowledged of the first consequence not only for the table but also for the feeding of hogs, cattle, and horses, every account showing the comparative excellencies of the different species of that kind of root will be of acknowledged utility to those persons attentive to improvements in agriculture."

Young constantly communicated letters on agricultural subjects to the Society. Thus, in 1772 he wrote on Siberian barley and on carrots and turnips, and in 1773 on sheep marking. In his Autobiography, some at any rate of which appears to have been written late in life, he says:—"This year (1772) I attended very much the meetings of the Society for the Encouragement of Arts, Manufactures, and Commerce, as well as the Committee of Agriculture, of which I was Chairman." But Young was not Chairman in 1772 or 1773. In 1774, 1775, and 1776 he was joint Chairman with Mr. John Arbuthnot.

Dossie's *Memoirs of Agriculture* was concluded with the publication of a third volume in 1782, and the Society, not satisfied with its former mode of conveying its proceedings to the public, decided in 1783 to commence the publication annually of a volume of Transactions, and the first volume was issued in that year. Young, in his Autobiography, claimed the merit of suggesting that the Society should publish its own Transactions. He wrote: "In a letter from Mr. Butterworth Bayley, he lamented the want of a respectable publication by the Society of Arts, and called upon me to think of some means of remedying the misery (*sic*). When I became Chairman of the Committee of Agriculture I was the first to propose that annual publication which afterwards took place. This proposition was at once acceded to, and Valentine Green, the engraver, had the impudence to assert that 'it originated with him.'" ("Autobiography," 1898, p. 59.)

In corroboration of this claim it may be noted that in a letter dated "Bradmore Farm, Feb. 15, 1769," preserved in the Society's archives, Young, referring to the publication of a paper of his, writes: "As I understand the Essays lately sent to the Society have not been published separately, but collectively, and not in the genuine Transactions of the Society, published by themselves or by their Secretary, but in a periodical work which can at least give no credit to such imperfect sketches as mine, that stand so much in need (to recommend them to the public) of the lustre of being inserted in the memoirs of the Society were such in being, but as nothing of this sort goes forward I shall be glad, if my essay meets with the honour it aimed at, to publish it with the Society's direction myself."

Young commenced in 1784 the publication of his own periodical the *Annals of Agriculture*, which he continued till 1806, when forty-five volumes had been issued. George III., who told Young that he learnt the principles of farming from his books, was a contributor to the *Annals*. Young himself wrote between a third and a fourth of the whole work, and when he became largely interested in other publications he does not appear to have frequented the Society of Arts meetings so much as formerly, although he continued a member until his death.

In 1793, the Board of Agriculture was founded and Young was appointed secretary. His office was in the house of Sir John Sinclair, the President, at Whitehall. In 1798, Sir John Sinclair was deposed from the presidency, and Lord Somerville took his place. A house in Sackville-street (No. 32) was obtained for the Board, and Young entered into residence there. It was in this house that he died on April 12, 1820, at the age of seventy-nine. Two years afterwards the Board of Agriculture ceased to exist.

Young was a remarkable man, who would have made a name in any vocation of life, and, in fact, it was somewhat of a chance that he became a farmer. In reviewing his career, he expressed regret that he had not been educated at the University for a clergyman, when he might have obtained his father's living of Bradfield. It was intended that he should become a merchant, but this scheme failed, and after his father's death, on the suggestion of his mother, he became a farmer. He wrote:—"I had no more idea of farming than of physic or divinity, and as it promised at least to find me some employment, I agreed to the proposition." He was a keen observer, and brought his brilliant intelligence to bear upon all the open questions of agriculture. He had hosts of friends, and impressed the great landowners and improvers of agriculture with the soundness of his views. He had also the pen of a ready writer, and was an accomplished pamphleteer as well as the producer of more important works, which record the incidents of his various tours. These were read with avidity when they were first published, and they still hold a high position in the literature of Agriculture and Political Economy. His "Irish Tour" (1780) had a most astonishing affect, for it caused an entire change in national opinion owing to his attack upon the bounty paid on the land carriage of corn to Dublin. In consequence of his advocacy the bounty was at first reduced and afterwards abolished, by which, according to Young, Ireland saved at least £40,000 per annum. (*See* "Autobiography," 1898, p. 86).

He wrote himself, "It has been very justly said that I first excited the agricultural spirit which has since rendered Britain so famous." There is no doubt that although an unsuccessful farmer he became in his lifetime the first European authority on agriculture. His name is also held in high esteem among political economists as a successful and practical worker in their science. In 1771, he published "Proposals to the Legislature for Numbering the People," but it was not until 1801 that his suggestions took effect in the production of the first census. In 1792 he proposed the foundation of corps of yeomanry cavalry, or, as he calls them, horse militia. The germ of Young's idea of forming a "militia of property," as stated by Sir Ernest Clarke, is contained in some reflections on the French Revolution at the end of his "Travels in France," published in May, 1792. In August, 1792, he repeated the suggestion in the 18th volume of his *Annals of Agriculture* (p. 491), and expanded it in his well-known pamphlet, entitled "The Example of France a Warning to England," which went through four English editions in 1793-4 (besides two editions in French—one published at Brussels and the other at Quebec), and which made a great sensation in its day. Some years afterwards, when dining at the Duke of Bedford's at Woburn, he was told by a captain of a troop of yeomanry that whenever the troop met he always drank Young's health after the King's, as being the undisputed originator of all the yeomanry corps in the kingdom.

Young was throughout life a poor man, and also to a great extent a disappointed and unhappy man, but honour was done to him by the worthiest men in the country, and he could record one tribute to his fame as a benefactor to the human race which is perhaps unequalled in history. Sir John Sinclair, when in Paris, met the Baron de Sylvestre, member of the *Institut* and Secretary of the French Society of Agriculture, who sent word to Young that he was the means of saving Sylvestre's life during the period of the Revolution. "He was in prison and brought to trial and told that his life should be saved if he could show that he had ever done anything really useful to the Republic. He replied "that he had unquestionably done good, for Arthur Young's 'Travels through France' contained much highly important information, and in order to spread it through the Republic in a cheap form he published a useful abridgment which has been much read and has had important affects." Sylvestre added "I was pardoned and set at liberty." ("Autobiography," 1898, p. 464.)

Young's powerful influence over all those with whom he came in contact forms a special feature of his life, and it appears to have been exhibited early in his career as may been seen from the following circumstances recorded in his Autobiography. In 1762, when he was 21 years of age, he projected a monthly periodical entitled "The Universal Museum," and asked Dr. Johnson to contribute to it, offering him any remuneration he might name. Johnson refused, and said, "No, sir; such a work would be sure to fail if the booksellers have not the property, and you will lose a great deal of money by it." Young was disappointed, but soon found out his mistake. He tells us:—"I printed five numbers of this work, and being convinced that Dr. Johnson's advice was wise, and that I should lose money by the business, I determined to give it up. With that view I procured a meeting of ten or a dozen booksellers, and had the luck and address to persuade them to take the whole scheme upon themselves. I fairly slipped my neck out of the yoke—a most fortunate occurrence, for, though they continued it under far more favourable circumstances, I believe no success ever attended it." Most men would say that he who could do that could do anything.

When James Barry was engaged upon the pictures which adorn the Society's Meeting-room, it was resolved that the picture of the Society should consist of portraits of the Past Presidents, Vice-Presidents, and the principal members. Great care was taken to get sittings from those who were chosen for this honour, and to obtain the best portraits procurable of the deceased members. The portrait of Arthur Young was introduced at the extreme left of the picture; his face is in profile, and he is represented as a farmer, producing specimens of grain to the President. Young was well acquainted with Barry, whom he had frequently met at the house of Dr. Burney. When Barry drew up his account of the pictures, which was printed in the third volume of the Transactions, he wrote to Young, asking him for his criticisms and corrections, and begging, in charity, that he would not spare the rod, adding, "I have on all hands got more praise than I well know what to do with, and something else may now be more profitable to me."

[The *Journal of the Royal Agricultural Society* contains two valuable papers on the subject of this article, viz. "Arthur Young," by Albert Pell (3rd S., vol. 4, p. 1, 1893), and "The Board of Agriculture, 1793-1822," by Sir Ernest Clarke (vol. 9, p. 1, 1898)].

THE PROFITS OF SUGAR-CANE CULTIVATION AND OF CANE SUGAR MANUFACTURE IN INDIA.

By F. N. G. Gill.

Now that the indigo industry of India is in such a depressed condition, and it has become a questi‸‸ with the planters of adopting cane cultivation more or less, the writer's experience may be of interest to them and others owning suitable land.

The sugar planter's business should be separate from that of the manufacturer, and where it is not it would be well if the planter treated the two branches of the business as separate businesses, each with its own account. In the present paper this course will be adopted.

Making jaggery will not pay if the planter can sell his cane to a central factory on the basis of Rs.16 8a. per 500 lbs. of jaggery yielded by it. Results of ryots' milling in South Arcot was found to be: 7·2 tons of cane crushed by two mills in twenty-four hours and obtained 18,744 lbs. of jaggery, equal to 3·75 candies of 500 lbs. (11·62 per cent. on cane):—

	Rs.	a.
3·75 candies of jaggery at Rs.16 8a.	61	14
Feed of 12 pairs of bullocks at 6a.......	4	8
15 candies firewood at R.1 4a.	18	12
4 men to mill, 8 men to boil, 2 men to collect bagasse, and 2 sundry men, day and night working	3	0
12 gunnies at 3a. 3p.	2	7
Sundries, repairs and interest on capital, say	4	7
	Rs.95	0

Making cost on spot Rs.25 5a. 3p. per candy of 500 lbs.

And to make the concrete with large steam mill, crushing 1 ton of cane in four minutes, and Fryer's concretor, the writer found the cost of the concrete Rs.24 per 500 lbs., bagged and on the spot. The ryots' working shown above is unnecessarily wasteful in fuel, even for open boiling; but as the jaggery in quantity would probably not fetch more than Rs.18 to Rs.22 on the spot, there is little hope of a margin in any case in such system of work.

The following are the results for 18 years, from 1879 to 1896, of cane cultivation in the South Arcot district of the Madras Presidency, obtained by native ryots with "Ribbon" cane grown under channel irrigation, and manured chiefly with ground-nut oil cake and, by the richer ryots, with indigo trash. The cane suffered considerably from water-logging through neighbouring paddy cultivation, and its seasons of planting and cutting were forced into unfavourable seasons of the year by the requirements of paddy cultivation. The whole of the cane of the area of cultivation referred to was sold to the sugar mills on the basis of the weight of jaggery (concreted juice) yielded by the cane. It might be good or it might be indifferent—really bad cane was rejected—jaggery, but the system was very much better than that of buying the cane outright, as it gave the ryot a strong, though not a perfect all-round, interest in the quality of his cane. The juice of each ryot's cane was accurately measured, and 15 gallons of it were boiled down to concrete over an open fire, in the country fashion, and the weight of concrete obtained, together with the gallons of juice measured, afforded all the data required for the settlement of the party's account. Such a system as this, however, would not go far enough with European sugar planters, even though thev were the owners—as they should be—of the central factory. Nothing short of the measurement of the juice and its polarization (to arrive at the quctient of purity or per cent. of sugar in apparent solids) would be found to be satisfactory to all interests.

Results of Cane Cultivation in South Arcot for 18 *years during which the extent of the cultivation and the results varied:*—

	From.	To	And averaged.
Extent of cultivation	129 acres	1,728	806½
Density of juice	9 Baumé	10·2	9·4
Cane crushed per acre	9·8 tons.	18·2	15·0
Jaggery, concreted juice, per acre	1·167 tons	2·189	1·754
	5·23 candies	9·80	7·86
Jaggery per cent. on cane	11·9	11·6	11·7

The weight of cane shown above is a closely approximate figure arrived at on the basis of the jaggery being 11·7 per cent. of the weight of the cane, the juice being of a density of 9·3° Baumé, and being obtained at the rate of 140 gal. per ton of cane, equal to 66·7 per cent. of juice.

If Rs.16 8a. per 500 lbs.. say Rs.74 per ton, be received for the jaggery in the cane, the gross proceeds per acre it is seen may vary from Rs.86 6a. to Rs.162, with Rs.129 12a. as an average. What the cost of cultivation, cutting, and carting of the crop are, and thence what the profit is, must depend entirely on local circumstances of distance of the cultivation from the factory, cost of land—rent, &c., labour, manure, and seeds. On the average, cane cultivation pays well if the jaggery in the cane can be sold for Rs.16 8a. per 500 lbs. delivered in the factory, supposing that the cartage to the factory does not cost too much. With yield of 11·7 per cent. jaggery on the cane, the ton of cane will give only 262 lbs. jaggery; and therefore 4 annas per cartload, and with three cartloads to the ton, will make a cost of Rs.1 per 500 lbs. of jaggery, or Rs.7 14a. per acre of average cultivation.

The profits of the central factory should be very considerable, buying the cane from the planters on the above, or somewhat analogous terms; and working with multiple effect evaporators, vacuum pans, crystallizers in movement and quick speed centrifugals, and with the factory designed for the conditions of the country. For a factory capable of dealing with 400 tons of cane a day and working for 100 days, equal to 2,666 acres of cultivation cleared in the season, probably 5 laks of rupees capital for building and machinery would be sufficient, and such a factory working an inferior cane with a refining value of the contained jaggery of 62·3 would turn out the bagged dry sugars at about Rs.34 per 500 lbs., valuing the treacle made at Rs. 6a. per 500 lbs., and allowing 7 per cent. on the capital for interest and depreciation, and including cost of permanent establishment for the remaining 265 days of the year. The cost would run out:—13,083 candies sugar, and 7,560 candies treacle.

	Rs.	a.
Materials (21,000 candies jaggery) at Rs.16 8a. and yield 62·3 per cent. ..	26	8
Repairs and renewals		8
Establishment	2	0
Fuel	2	6
Gunnies, inner-bags and twine	1	3
Filter-bags and sheaths		2
Oil and sundries		4
Charring		8
Permanent establishment (in slack season) and insurance	1	5
Interest (5 per cent.) and depreciation (2 per cent.) on Rs.5,00,000 at 7 per cent.	2	11
	37	7
Less 7,560 candies treacle at Rs.6	3	7
Nett cost..	Rs.34	0

The sugars would realise on the spot a minimum average price of Rs.48 per 500 lbs., leaving a profit of Rs.14 on 13,083 candies equal to Rs.1,83.162. The realisation of the treacle, however, is a difficult matter, and is generally impossible in the working of an inferior cane without a distillery which to deal with the 7,560 candies treacle would have to be capable of turning out about 20,000 gallons proof spirit a month, and an outlet for this spirit would have to be found. The alternative, which would still leave a very good profit, of throwing away the treacle, in part or in whole, is not always possible as there may very well be no place into which treacle in quantity can be run without causing a nuisance. If a distillery can be worked it can make its own profit out of the Rs.6 per 500 lbs. treacle paid the sugar house, the spirit costing only between 6 annas and 7 annas per gallon proof, including 10 per cent. (5 per cent. depreciation as it would work all the year round) interest and depreciation on $1\frac{1}{2}$ laks of distillery buildings and plant.

If the "Ribbon" cane be not water-logged, be planted seasonably in favourable soil, and be sparingly manured, its jaggery contents may have a refining value of over 74 per cent. as also may the "Dikchan" (Dr. Leather's analyses) of Shahjahanpur, and the soft green cane (turning mellow-yellow when dead ripe) of Coimbatore; and then, while the weight of cane per acre may be considerably less than with more stimulated growth, the greater value of the jaggery contents would permit of the central factory paying a proportionate price for it. Thus: — (15,540 candies sugar and 5,040 candies treacle).

Gross cost would be—

	Rs.	a.	p.
$\frac{\text{Rs.37 7a.} \times 62{\cdot}3}{74{\cdot}0}$	31	8	3
And treacle credit—			
$\frac{7{,}560 \times 6}{15{,}540}$	2	14	8
Nett cost	Rs.29	9	7

The difference between this and Rs.48, Rs.19 6a. 5p. would be the profit per candy of sugar working the better cane—

		Rs.
15,540 cds. of sugar at Rs.19 6a. 5p.		3,01,491
5,040 cds. of treacle at Rs.6		30,240
		3,31,731
13,083 cds. of sugar at Rs.14 ..	Rs.1,83,190	
7,560 cds. of treacle at Rs.6 ..	45,360	
		2,28,550
	Difference..	Rs.1,03,181

equal to Rs.4 14a. 7p. per candy of the 21,000 candies of jaggery, which the sugar works can afford to pay the planter for such cane.

On the other hand, the planter can afford to grow as little as an average of 11 tons of cane per acre at Rs.21 6a. 7p. per candy of jaggery, as against 15 tons with the jaggery at Rs.16 8a.

There is another possibility with the better cane—that of working the treacle for its sugar through a prelimihary treatment of the cane juice and a final treatment of the treacle, and so being entirely independent of a distillery for the realisation of the treacle. As regards the preliminary treatment, the writer has not worked it on cane juice, but has worked it on several thousand tons of jaggery in refinery blow-up and scum liquors, and with glucose content of 4 and 5 in the 100 apparent solids, equivalent to, in the case of ordinarily constituted cane juice, $\frac{3}{4}$ to 1 per cent. glucose in the juice, and with the result that the treacle contained only 1·4 glucose in the 100 solids, or 1·2 per cent., and accordingly quite fit to be treated by the final—the Steffen Lime Separation—process. The writer has not worked this process, but he went to Germany to inquire about it in 1885, and in 1891 he went to Europe specially to go into the question of the advisability of its adoption in consequence of the oppression and vexation to which the business was subjected by officials through the distillery. The result was that the writer could not recommend the immediate adoption of the process which would have involved the outlay of $1\frac{1}{2}$ to 2 laks of capital, and with a distillery already on hand; and when, too, it was found that what was urgent was the adoption of crystallisation in movement. In the end this view was not justified, and with his experience now the writer would not recommend the investment of capital, under any circumstances, in a business dependent on official suffrance in India, where the revenue official of heterogeneous origin and early training is invested with absolute power in anomalous capacities and is free from the restraints of public opinion.

From the foregoing it follows that the writer would strongly recommend the adoption of the Steffen separation process in sugar-making in India, where possible. Applied to sugar-cane juice with the preliminary destruction of glucose referred to, the position would

be as follows, working the better cane with juice containing a maximum of 1 per cent. glucose.

Crushing 400 tons a day and obtaining 66·7 per cent. juice* containing 1 per cent. glucose, there would be obtained 8·7 tons of treated treacle, requiring 5·6 tons of lime for its treatment, and giving in the saccharate formed—and which would be used for the destruction of the glucose in the following day's cane juice—rather more than twice the lime required for such purpose. Under the circumstances the lime expense is limited to the treatment of the treacle.

The following would be the cost of treating a day's out-turn of treacle :—

		Rs.	a.	p.
39 candies treacle at Rs.6		234	0	0
Establishment :—30 men at 3a.	Rs.5 10a.			
Supervision	10 0			
		15	10	0
Fuel, 10 cwt. coal (only pumping, stirring, and lime-grinding required, decomposing the saccharate in the cane juice) at Rs.15		7	8	0
Filter-bags		9	0	0
Lighting and repairing		10	14	0
Lime, 5·6 tons at Rs. 11 8a.		64	6	0
40 I.H.P. for cooling machine, at 4 lbs. coal per hour for 10 hours		10	11	5
Labour, oil, and sundries		4	8	0
Fitting, &c.		1	8	0
Interest and depreciation (7 per cent. on Rs.10,000)		70	0	0
		Rs.428	1	5
Value of 16 candies rough sugar in the cake, which if separated would have an average polarisation of 94·7, at Rs.35 8a.		568	0	0
Value of 5 candies of treacle, say, nothing				
		Rs.139	14	7

Or, say, Rs.140 per day, Rs.14,000 for the season, but from which has to be deducted the cost of the preliminary process of the destruction of the glucose in the juice, beyond the cost of the lime met in the final process. Plant, consisting of two large gas pumping engines (to take the boiler flue gases), and gas-scrubbers, three large tanks, pipes, &c., and more filters would be required, involving a capital expenditure of about Rs.30,000, which at 7 per cent. is equal to Rs.2,100, debit which on 15,540 candies of sugar = Rs.0 2a. 3p., and labour, fuel for gas-pumping, and more filter-bag wear, 1a. 9p., total, Rs.0 3a. 0p. per candy, or Rs.2,913 12a., making a nett profit on the process of Rs.14,000 less, say, Rs.2,814, equal to Rs.11,086.

* This was the yield ascribed with a density of juice of 9·3° B., but the juice of the better, non-stimulated growth of cane would have a considerably greater density, and hence, probably, the yield of juice would be greater; but this is a detail that need not be considered.

The Steffen separation process, it may be mentioned, consists in combining the sugar of the molasses with lime to make an insoluble saccharate which can be washed free from impurities in a filter press. It necessitates the employment in the tropics of an ice machine, used simply as a cooling machine for keeping the temperatures of the liquors and water in use within 60° Fahr., but as ice machines are at present made this is not a serious matter, and the cost of it has been fully provided for in the above statement.

It will be noticed that a large quantity of lime is required. Further, the limestone burned must be very pure, and it must be burned on the spot. A very good source of lime would be cockle or such shells, washing them before burning if sea shells.

Summary of Profits—Working 400 tons cane a day for 100 days.

1. Taking the inferior cane with its contained jaggery of 62·3 refining value, costing Rs.16 8a., and

(*a*) Supposing the whole of the treacle is worked in a distillery, and the spirit sold at 1a. profit per gallon proof, equal to a selling price on the spot of, say, 8a.

(*b*) Supposing there is no distillery, and that the treacle can be, and is, thrown away.

	(*a*)	(*b*)
13,083 cds. sugar at Rs.14	Rs.1,83,190	Rs.1,83,190
2,16,000 gals. proof spirit at 1a.	13,500	
Less value of 7,560 cds. treacle cred.		45,360
	Rs.1,96,690	Rs.1,37,830
On capital of	6½ laks=30·2%	5 = 27·5%

2. Taking the superior cane with its contained jaggery of 74 refining value, and supposing that the treacle is worked by the Steffen process as described,

(*a*) Paying Rs.16 8a. for the jaggery in the cane.

(*b*) Paying Rs.21 6a. 7p. for the jaggery in the cane.

	(*a*)	(*b*)
15,540 cds. sugar at Rs.19 6a. 5p.	Rs.3,01,491	Rs.3,01,491
Profit of the Steffen process	11,086	11,086
	3,12,577	3,12,577
Less Rs.4 14a. 7p. more paid on 31,000 cds.		1,03,181
	Rs.3,12,577	Rs.2,09,396
On a capital of Rs.6,30,000	49·6%	33·2%

It is a question whether, in regard to the profits shown in working the Steffen process, if the treacle ultimately left would not have a considerable value for manurial purposes, and certainly the lime sludges (and wash waters under favourable conditions of elevation of factory in respect to neighbouring cultivation) would have such a value beyond the cost of their distribution.

All said and done, however, no process for the profitable absorption of treacle can beat that of the human stomach, and it would be of immense value to the sugar industry of India, and to the working classes of India, if the popular consumption of treacle could be brought about: Cane treacle at 5 pies a seer (2·05 lbs.), on the spot, would be a remarkably cheap food-stuff, and would give a realisation to the sugar works of Rs. 6 8a. per 500 lbs. for its treacle.

THE INDUSTRIES OF MEXICO.

Mexico is not, strictly speaking, a manufacturing country. Such articles as the mass of the people require are, however, generally produced in sufficient quantities to meet the demand, but Mexico will hardly become, for very many years at least, a manufacturer of articles beyond those of which she produces the raw materials. The principal industry of the country is the making of cotton cloth, mostly *manta*, a coarse unbleached cotton fabric. It has been estimated that the mills of the country consume annually 26,000,000 pounds of cotton, quite a large portion of which is imported from the United States. The industry gives work and support in the field and mills to more than 50,000 families. The ordinary cotton cloth *manta*, which is about the only material for clothing, used by two-thirds of the inhabitants of the country, is usually made up in pieces of 30 yards 4 inches in length, by 34 inches in width. Besides the cotton cloth and prints, a considerable amount of cotton yarn is used in the manufacture of *rebozos* (an article serving as a shawl and scarf for women), blankets and coarse napkins. The best *rebozos* are made in the town of Tenancingo. The articles named are also manufactured of silk and linen. There are in the city of Mexico several factories devoted to the manufacture by hand of *zarapes*, *rebozos*, *mantas*, and other cotton stuffs. According to a recent report by the Bureau of the American Republics, the manufacture of knit goods such as hosiery, underwear, &c., has increased considerably, and has resulted in making a very noticeable reduction in the amount of imported goods of this character. Mexican industry also produces woollen blankets and blankets of a mixture of wool and cotton and casimeres, which, although they have not the body and fineness of texture of those of European manufacture, have on the other hand great resistance, and are cheap. The *zarapes* constitute perhaps the most profitable industry. These multi-coloured woollen cloaks are all well made, those of Saltillo and San Miguel being celebrated for their fine texture, brilliant colours, good finish, and excellent wearing qualities. The principal woollen mills are at Aguascalientes, Durango, Guanagnato, Hidalgo, and Puebla. San Louis Potosi, Zacatecas, Mexico, and Nuevo Leon also have woollen mills which produce a fair quality of goods. It is not generally known that wool spinning has been going on in Mexico for more than three centuries, yet such is the well authenticated fact. In the year 1541 the first Viceroy introduced Merino sheep into the country, and established manufacture of woollen cloth. Silk-weaving can hardly be said to be a great industry at present, but is increasing rapidly. Silk was cultivated and sold in the markets of Mexico as far back as the time of Charles V.—Cortés speaking of the fact in his letters to that monarch—and there are still preserved pictures done by the ancient Mexicans upon a paper made of silk. The culture of the silkworm and weaving of its product were prohibited by the Spanish Crown in its American possessions during the Vice-Regal administrations. The industry gradually died out, and it is only of late years that it has been revived. The climate of Mexico is unrivalled by any in the world for the raising and developing of cocoons. The silkworms, at the present time, are raised chiefly at Oaxaca, in the State of the same name; Tetela, in the State of Puebla; Ixmiquiltam, in Hidalgo; and in the States of Jalisco, Flaxcala, Mechoacán, Queretaro, Vera Cruz, Chihuahua, and Zacatecas. A silk-grower of San Louis, Potosi, has recently imported 500,000 mulberry trees from France, and in order to encourage the silk industry these trees were admitted into the country free of duty. Considering the great quantity and variety of fibrous plants and other material for paper making with which Mexico is endowed, and this industry has been protected for many years by the Customs Tariff, it is strange that throughout the entire territory there are only a few paper mills which manufacture comparatively little writing paper, but a considerable quantity of wrapping and printing papers, envelopes, &c. The oldest mill is that at Cocolapan, in Orizaba, which produces a straw and printing paper of low grade. Save in the State of Morelos, and some districts in the States of Puebla, Vera Cruz, Michoacan and Jalisco, and the territoiy of Lower California, the sugar industry is very backward. In most of the sugar mills the juice of the cane is extracted by wooden cylinders and boiled down to the necessary consistency to form small tablets or cakes (called *panelas* or *piloncillos*) of a dark brown saccharine substance called *panocha*. Except in rare cases, the use of steam and modern machinery is unknown. That this is a profitable industry is shown by the fact that the sugar mills of Tenango, Santa Clara, and San Ignacio, in the State of Morelos, paid back to their owners the total of their investment within four years. Distilleries are to be found all over the country, yet very few of them have modern plants. These distilleries are chiefly engaged in distilling the liquor *mescal*. This is a strong alcoholic beverage, colourless, or of a very light amber tint. It is distilled from the root of the *Maguey mescal* or *teguila* (*Agave Americana*), and Mexicans claim that it has good stomachic qualities, but it is a great intoxicant. Another liquor made in Mexico is distilled from the sugar-cane, and is called *aguardiente*. A very fair native wine and brandy are made from grapes, but this industry is not

a prominent one, and does not supply the home demand. Beer and ale of an excellent quality are produced. Official figures for the years 1898-99 show that there were then in the country 2,211 establishments devoted to the manufacture of spirits from sugar cane, maguey, grapes, grains, &c., which produced during that year 39 million litres of spirits (about 34 million quarts). The number of stills in use amounted to 2,638. The tobacco utilising industry is extensive, nearly every town and hamlet having its cigarette factory. The largest manufactories of cigars and cigarettes are in the Federal District, Puebla, and Vera Cruz. The quantity of tobacco manufactured in the country in 1898-99 amounted to 5,546,677 kilogrammes (12,203,000 lbs.) Iron foundries are numerous, the excellent quality of the Mexican minerals and their abundance making it possible for them to turn out good work. Figuring among the prominent industries of the country is hammock making. This is principally carried on in the State of Yucatan, where hammocks have been articles of use and barter from time immemorial, which fact has been demonstrated by the discovery in buried cities of hammock beams and hooks. Yucatan exports more hammocks than any other province in the world. These articles are made from the fibre of the *henequén*, and are woven entirely by hand with the aid of a very few primitive instruments. All that is necessary to make a hammock is a couple of straight poles and shuttles, a thin slat of *zapoli* wood, and a pile of *henequén* leaves. With these articles at hand a Yucatan native is prepared to accept contracts for hammocks by the piece, dozen, or hundred. Pottery is classed as a third-rate manufacture of the country, and is made anywhere. The cities of Guadalajara, Zacatecas, Guanajuato, and Puebla may be said to be the centres of the industry. Among other industries the following may be mentioned:—The collecting and exporting of hides and skins; pearl fishing; the killing of sea lions on the coast of Lower California; the manufacture of acids and chemical compounds, jewellery and trinkets, chocolate and hardware. Among the distinctively Mexican industries are the beautiful drawn work and feather work, in the making of which, as well as in the spinning of horse-hair, *riatas*, or lassoes, which every Mexican *charro* carries on the pommel of his saddle, the natives of the country are unexcelled.

PRODUCTS AND RESOURCES OF UGANDA.

About two-thirds of the area of the Uganda Protectorate is endowed with a singularly fertile soil. Kavirondo, the slopes of Mount Elgon, the Suk Hills, Busoga, the kingdom of Uganda, and the districts of Unyoro, Toru, and Aukole, together with all the islands in the northern half of the Victoria Nyanza are exceptionally fertile. Sir H. H. Johnston, H.M. Special Commissioner in Uganda, says it is difficult to estimate what wealth of agricultural products might issue from these countries if they were cultivated by an industrious Asiatic race. All that is to be hoped for under present conditions is that the negro will awake to an idea of the wealth which lies in his untilled soil, and realise that he may become a wealthy man if he will only be reasonably industrious. At present, in agriculture, the races of the Uganda Protectorate, except in the far north towards the Nile, are singularly backward even for Africans. In most of the countries described above as being exceptionally fertile the principal food of the natives is the banana. This remarkable plant requires scarcely any labour in these countries for its maintenance as a standing source of food supply. It propagates itself by throwing up shoot after shoot from the underground rhizome, which, as it were, grows horizontally, as do many of the allied plants of the same order (*Zingiberaceæ*) and most orchids. From one of these rhizomes an incipient shoot can be broken off and replanted. This shoot rapidly develops into a fine tall tree and bears one or more bunches of fruit. Whilst this tree is flourishing above ground it is expanding horizontally below ground and forming a succession of fresh shoots. Each shoot grows up in turn, produces fruit and eventually dies. Left to themselves, however, bananas seem to go on growing, shooting, dying, and sprouting up again externally. Beyond the original labour of stocking a new banana plantation with fresh shoots, the native has little further to do but to gather the fruit as it ripens. Ordinarily, however, the plantains or bananas are gathered in an unripe state and eaten cooked. From the ripe fruit a sweet beer is made. The leaves and stem of the banana and its watery sap have also their uses. Except perhaps wheat, oats, and barley, almost any grain grows luxuriantly in the lower lying parts of the Uganda Protectorate, while wheat, barley, and oats, so far as can be judged by experiments, thrive on the uplands and in the drier districts to the north of Lake Rudolf. Before the British occupation, no rice was grown in the country, but now, in the vicinity of Kampala and Entebbe, all the swamps and watery valleys are being turned into rice plantations. In the north-eastern and northern parts of the Protectorate, between the Nile and Lake Rudolf, ground nuts are grown in large quantities. The potato is now being largely cultivated by the Baganda for sale to Europeans. It thrives splendidly in the country, as do its valuable relations, the tomato, the brinjall, and the tobacco plant. Uganda tobacco is of excellent quality, and it is stated, from experiments which have been made at Kampala, that it will prove a superior leaf for cigar wrappers. Coffee grows wild over all the more hilly districts of the Uganda Protectorate. When properly prepared it has a delicious flavour, and is fit to be put on the market as gathered from the wild bushes. Coffee yields the most encouraging results under cultivation, and it is the opinion of Mr. Whyte, the Director of the Scientific and Agricultural

Department in Uganda, that the kingdom of Uganda and the adjoining districts of Busoga, Unyoro, and Toru, are destined to be the great coffee producing countries. The soil, the water supply, and the abundance of shade from forest, offer conditions and advantages rarely present in equal force. Cotton grows wild or half wild in many places, and is to some extent cultivated in the North Province chiefly on the sites of Emin Pasha's former settlements. It is of good quality and long staple, but except for local purposes it is not worth consideration, as it would probably never pay to export it over the railway to the coast. The castor oil plant grows abundantly, and the oil, which is very easily obtained by crushing, is very useful for lubricating purposes. Sesamum seeds yield good oil. Rubber (chiefly from two species of Landolphia, from a *ficus* and perhaps from a tree called *Tabernœmontana*) is probably abundant in every thicket of the Protectorate, below 5,000 feet in altitude. Rubber will, it is said, probably become a very important item of the Uganda exports, but at the present time, although the natives know of its existence and the trees which produce it, they make little or no effort to collect it for sale The ebony tree (*Diospyrus*) grows in the western forests, where also the camwood (*Raphia*) is found. A common tree on Uganda is the "incense" tree, the constantly exuding gum of which is the principal ingredient in incense. Sir H. H. Johnston says that he does not remember to have seen this tree growing in such numbers in any other part of Africa, or for it to be so easy to obtain its delicious smelling gum. As a matter of fact when it is desired to fumigate a house or room and to replace the mustiness of the dwellings by an agreeable odour, it is only necessary to send a native servant to a short distance to scrape the exudations off the incense tree and place these on hot charcoal and a delicious smell of incense at once arises. It is expected that the splendid timber which can be obtained from the Mau forests will be an important article in the future exports of Uganda. This timber will be derived from three conifers —a juniper and two species of *Podocarpus*. It is not anticipated that this timber would be worth exporting to England, but it would certainly vie with Scandinavian timbers on the East Coast of Africa, and even perhaps in India, the more so as it is said to be left untouched by the white ant. All the southern half of the Uganda Protectorate to the south of the second degree of north latitude is a country of forests. In the forest-regions of Uganda, below 5,000 feet, there are two kinds of palm represented—the Makindu, or wild date, and a magnificient species of *Raphia*, which unlike other *Raphia* palms, towers to a great height of stem. The trunks of the date palms are employed for many purposes in building. They make excellent piles for wharves or piers; columns, for supporting the verandahs of houses; in fact they can be turned into a variety of purposes, and there is such demand for them that some forestry regulations are to be instituted to protect them from undue destruction The mid-ribs of the *Raphia* palm fronds, which are of enormous length, are also very useful articles as rafters. The sugar-cane thrives wonderfully in the better parts of the Uganda Protectorate. It is cultivated in nearly all the native gardens. Individual canes are often met with 15 feet long, robust and long pointed, and as well developed as the average cane in the West Indies. The Uganda sugar-cane goes on ratooning for years, and forms a considerable item in the native dietary. Almost all English vegetables grow and are grown in the Uganda Protectorate with encouraging success. Orange, lemon, and mango trees, which were planted a few years ago have done exceedingly well, but except on the Mau Plateau it would be impossible to grow stone fruit, apples, pears, or any of those trees which require a real winter. As regards animal products, first in importance comes the elephant. The ivory is of first rate quality, and the tusks of the male elephants are often of exceptional size and weight. The Uganda Protectorate is essentially a cattle-keeping country; only uninhabited districts like the Mau forests on the summits of high mountains, and perhaps some of the desert country near Lake Rudolf, are without herds of cattle belonging to the natives. These cattle belong to two very distinct stocks. In the east and centre and on the Shuli, Madi, and Bari countries of the Nile, the oxen are of the Indian zebu type with a hump, a considerable dewlap and short horns. The cows of this kind are often polled. In the northern part of the Rudolf region, on the uplands to the east of the Nile, and again far away to the south-west in Ankole, is the remarkable Galla ox, the horns of which are enormous. The animal is usually of large size, generally a dun or fawn colour, and with a straight back or only a small hump. Horses thrive almost everywhere in the Uganda Protectorate, while the wild ass is indigenous to the desert regions round the northern shores of Lake Rudolf, and possibly also between Lake Rudolf and the Upper Nile. The zebra is a very common animal in the low lying parts of Uganda. No attempt has yet been made on the part of the natives to domesticate it. The country to the west of Lake Rudolf possesses camels. These animals, however, would only be of use in the dry regions of the eastern parts of the Protectorate, as elsewhere the climate would be too humid. The natives keep large herds of small goats and sheep. A good deal of beeswax is obtained from the wild bees in most parts of the country, and might be a future article of export. As regards minerals, except that iron exists in most parts of the Protectorate, and is easily worked by the natives, little is known of the existence of other metals. Copper is vaguely reported from some of the Nile countries, but no precise information is at hand. In the same way, gold is said to be found by the natives in the gravel of river beds on the north-west of Lake Rudolf. In these respects the country has been so little explored that

it is impossible to say whether it may turn out to be very rich in precious metals, or very poor. Coal is reported to be found on the slopes of Mount Elgon.

CHINCHILLA SKINS.

Killing chinchilla with the aid of dynamite is one of the pastimes of the South American Indians which enriches the commerce of the world very considerably. This season more than ever before chinchilla has been the fashionable fur used in the manufacture of cloaks and muffs and for the trimming of costly hats.

High in the mountains the nimble-footed chinchilla are caught and killed by half-savage Indians. Tact and skill are needed to allure the cautious little animal from its hole in the earth. Originally the Indians used cactus prongs, which are long and sharp, to capture them in their holes by impaling them on the end of this natural spear. This punctured the skin and impaired its value. The trappers tried to smoke the chinchilla out by making great fires near the entrance of the burrows, but the smoke, it was found, caused the skin to turn yellow, which seriously depreciated its value. Now the more progressive Indians use dynamite.

After locating the chinchilla they form a network of grass and hardy plants, which is placed around the hill on the side of which the animal digs its holes. A dynamite cartridge, with a time fuse attached, is then discharged in the centre of the net, which frightens the chinchilla so that they leave their holes and scamper wildly to and fro about the space inside the net. The Indians then dash into the arena with clubs and kill them by striking them over the head. This is considered the easiest and best method of killing them, as it does not in any way damage the skins, which vary in value from $3 to $15 each. When it is considered that as many as 100 animals are killed in one sortie of this character, the value of skins to the Indians, who are shrewd commercial traders, may be imagined.

Four times a year the tribes descend into the semi-civilised villages at the base of the mountains with their skins. There they are met by the various agents of the European fur houses. One American house has its representative there too. The occasion of the Indians' arrival is usually made a religious festival.

George Herzig, the only American agent there, says that he paid one tribe of 30 Indians for the firm by whom he is employed as much as $80,000—in native money, which is equivalent to $30,000 in American money—last year for skins. This the Indians converted principally into mule and llama stock, by which they estimate their wealth.—*Leather Trades Review.*

THE EXHAUSTION OF EUROPEAN COALFIELDS.

In his last report, the British Consul-General at Berlin, calls attention to an interesting publication, the work of the celebrated Breslau geologist—Professor Frech. It treats with much fulness the question—"When will our coalfields be exhausted?" According to Dr. Frech's calculations Germany is the richest country in Europe in future stores of coal, and is only superseded in this respect by North America and North China. The present production of coal in England is actually higher than that of Germany, but this denotes a more rapid exhaustion of coal stores. The article concludes with tables showing the probable time of exhaustion of the principal European coalfields, duration of 100 to 200 years. The coalfields of Durham and Northumberland, Central Bohemia, Kingdom of Saxony, Province of Saxony (coal all but exhausted). The thinnest layers of coal and the smallest number of seams are to be found in the coalfields of Central America, duration of 200 to 250 years; all other British coalfields, 200 to 300 years; Waldenburg, Schaltzlarer district, 300 to 400 years; Northern France, 600 to 800 years; Saarbrucken district, Belgium, Aix-la-Chapelle, and the contiguous Westphalian district, including the Ruhr, 1,000 years and upwards. The greatest number and the thickest coal seams are found in the coalfields of Upper Silesia, its eastern prolongation — Russian Poland, and its southern prolongation—Moravia.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 12...Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. George Berry, "Western Australia in 1900."

Surveyors, 12, Great George-street, S.W., 8 p.m. Opening Address by the President, Mr. John Shaw.

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

British Architects, 9, Conduit-street, W., 8 p.m. Prof. Lanciani, "Architectural Results of the latest Excavations in the Forum."

London Institution, Finsbury-circus, E.C., 5 p.m. Sir Robert Ball, "The Earth's Beginning."

TUESDAY, Nov. 13...Civil Engineers, 25, Great George-street, S.W., 8 p.m. Messrs. George Andrew Hobson and Edmund Wragge, "The Metropolitan Terminus of the Great Central Railway."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. W. Maunder, "Photography in the Eclipse of May 28th, 1900."

Colonial, Whitehall-rooms, Whitehall-place, S.W., 8 p.m, Sir Gerard Smith, "Recent Observations in Western Australia,"

THURSDAY, Nov. 15...Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. C. Worsdell, "Contributions to the Comparative Anatomy of the Cycadaceæ." 2. Miss Alice L. Embleton, "On a New Parasitic Copepod."

Chemical, Burlington-house, W., 8 p.m. 1. Profs. F. C. Garrett and J. A. Smythe, "The Bases contained in Scottish Shale Oil."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. C. Macpherson, "Scottish Songs and Music."

FRIDAY, Nov. 16...Mechanical Engineers, Storey's-gate, St. James's-park, S.W., 8 p.m. Mr. J. D. Twinberrow, "Capacity of Railway Wagons as Affecting Cost of Transport."

SATURDAY, Nov. 17...North-East Coast Institute of Engineers and Shipbuilders, 8 Nicholas-buildings, Newcastle-on-Tyne, 7 p.m. Mr. H. J. Potts, "Comparison Between British and American Locomotive Practice."

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FRIDAY, NOVEMBER 16, 1900.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

Notices.

ARRANGEMENTS FOR THE SESSION.

The First Meeting of the One-Hundred-and-Forty-Seventh Session will be held on Wednesday evening, the 21st of November, when an Address by SIR JOHN EVANS, K.C.B., F.R.S., Vice-President and Chairman of the Council, will be delivered.

Previous to Christmas there will be Four Ordinary Meetings in addition to the Opening Meeting. The following arrangements have been made:—

NOVEMBER 21.—Opening Address of SIR JOHN EVANS, K.C.B., F.R.S., Chairman of Council.

NOVEMBER 28.—"Malaria and Mosquitoes." By MAJOR RONALD ROSS. PROF. E. RAY LANKESTER, LL.D., F.R.S., will preside.

DECEMBER 5.—"Road Traction." By PROF. H. S. HELE-SHAW, LL.D., F.R.S. SIR ALEXANDER BINNIE will preside.

DECEMBER 12.—"The Treatment of London Sewage." By PROF. FRANK CLOWES, D.Sc.

DECEMBER 19.—"The Siege of Ladysmith." By W. T. MAUD (special artist to the *Graphic*).

Papers for meetings after Christmas:—

"Recent Inventions in Weaving Machinery." By PROF. ROBERTS BEAUMONT.

"Multicolour Printing." By ELMER Z. TAYLOR.

"The Synthesis of Indigo." By PROF. RAPHAEL MELDOLA, F.R.S.,

"School Work in Relation to Business." By SIR JOSHUA FITCH, LL.D.

"Evolution of Form in English Silver Plate." By PERCY T. MACQUOID.

"Clocks, Carillons, and Bells." By A. A. JOHNSTON.

"The Proposed High-Speed Electrical 'Monorail' between Liverpool and Manchester." By F. B. BEHR.

"Photography of Natural Colours by the McDonough-Joly Process." By H. SNOWDEN WARD.

"The Outlook for the World's Timber Supply." By DR. W. SCHLICH.

"Patent Law Reform." By ALEXANDER SIEMENS.

"Modern Artillery." By LIEUTENANT ARTHUR TREVOR DAWSON, late R.N.

"Testing Distant Vision." By R. BRUDENELL CARTER, F.R.C.S.

INDIAN SECTION.

The meetings of this Section will take place on the following Thursday afternoons, at 4.30 o'clock:—

January 17, February 14, 28, March 12, April 16, May 16.

COLONIAL SECTION.

The meetings of this Section will take place on the following Tuesday afternoons, at 4.30 o'clock:—

January 22, February 19, March 19, April 30.

APPLIED ART SECTION.

The meetings of this Section will take place on the following Tuesday evenings, at 8 o'clock:—

January 29, February 12, 26, March 12, April 16, May 21.

CANTOR LECTURES.

The following courses of Cantor lectures will be delivered on Monday evenings (except December 3), at 8 o'clock:—

PROF. JOHN A. FLEMING, M,A., D.Sc., F.R.S., "Electric Oscillations and Electric Waves." Four Lectures.
November 26; Tuesday, December 4; Monday, December 10, 17.

J. LIBERTY TADD, "Elementary Art Education." Four Lectures.
January 14, 21, 28, February 4.

W. J. POPE, "The Bearings of Geometry on the Chemistry of Fermentation." Four Lectures.
February 11, 18, 25, March 4.

MAJOR P. CARDEW, "Electric Railways." Three Lectures.
March 11, 18, 25.

SIR WILLIAM CHANDLER ROBERTS-AUSTEN, K.C.B., F.R.S., "Alloys." Four Lectures. April 22, 29, May 6, 13.

JUVENILE LECTURES.

Two Lectures, suitable for a Juvenile audience, will be delivered on Wednesday afternoons, January 2 and 9, at half-past Four o'clock, by E. WALTER MAUNDER, F.R.A.S., Superintendent of the Solar Department, Greenwich Observatory, on "Eclipses."

CANTOR LECTURES.

The annual dinner of the Institution of Electrical Engineers has been fixed for Monday, the 3rd of December. The second lecture of Professor Fleming's Cantor course on "Electric Oscillations and Electric Waves," announced for this date, will be postponed until the following day, Tuesday, December 4th, at 8 o'clock, to suit the convenience of members and others who might be prevented by the dinner from attending it.

MANUFACTURE OF SYNTHETIC INDIGO.

On the occasion of the opening, on the 20th October, of the new premises of the German Chemical Society in Berlin, named after the late Professor "Hofmann Hans," Dr. Brunck, the principal managing director of the Badische Anilin und Soda Fabrick, delivered a lecture upon the manufacture of synthetic indigo. The following report is taken from *The Times* :—

Dr. Brunck first referred to the advantages offered by synthetic indigo as compared with vegetable indigo. Its purity, constant uniformity of composition, and ready reducibility in the dyeing process benefit the dyer considerably, for on the one hand he always knows exactly what he is buying, and on the other they make it possible for indigo to be used with success by less highly skilled workmen than was formerly the case. Vegetable indigo as sold varies in composition, and it required a peculiar skill in the dyer to attain with certainty a desired shade whilst using a dye of varying composition. The various prejudices against the introduction of the synthetic product were next dealt with. While some critics have stated that the impurities in vegetable indigo are essential to the dyeing process, others at the same time have gone so far as to say that the indigo of the Badische firm is not really synthetic, but merely refined vegetable indigo. Most difficulty has arisen from the fact that people in general cannot grasp the idea of chemical individuality, and fail to realise that identically the same body can be obtained from two different sources, as, in the case of indigo, from a plant and from the artificial synthesis of other substances. As a consequence synthetic indigo has been regarded by some as a substitute or surrogate for natural indigo and classed with aniline dyes giving similar shades. All these prejudices are giving way before a better knowledge of the facts.

The development of the manufacture has been enormous. Already about £900,000 has been invested in the indigo department and laboratories of the Badische Company, and it is calculated that the quantity of indigo produced annually in Ludwigshafen would require the cultivation of more than 100,000 hectares—that is, a quarter of a million acres—of land in India. In July, 1897, the company built factories sufficient to supply the demand of Germany for indigo, and these were so planned as to fit in with a larger scheme if they proved successful. Success was perhaps not altogether certain, for not only was it impossible to say whether the vegetable indigo could not be reduced considerably in price, but there was always the danger that other chemical processes for the manufacture of the product might arise. But the factories have been, and are being, constantly increased in size until the yield has assumed the proportions mentioned above, and the lecturer expressed most sanguine expectations that the manufacture in Germany would emerge triumphant from the competition with the Indian indigo planters. Discussing the consequences for the indigo-planting districts in this case, he suggested that the land now devoted to the production of indigo might with advantage produce food stuffs, which would be available in fighting future famines, and, while disclaiming any endeavour to pose as an impartial adviser, he stated it as his firm conviction that the Government of India would be acting in the best interests of India if it immediately grappled with the question as to what could best be done with the land hitherto devoted to the cultivation of indigo and arranged for its systematic conversion to other uses.

The greater part of the lecture was devoted to a discussion of the steps by which this success has been rendered possible. Under this head Dr. Brunck first referred to the processes for the manufacture of indigo based upon the researches of Adolf von Baeyer and starting from the hydrocarbon of coal-tar known as toluene. Such methods are of comparatively small importance, because the quantity of toluene available for use as raw material is limited ; it is calculated that the total quantity of toluene at present produced would only suffice for the manufacture of about one-fourth of the quantity of indigo used annually, and the whole of it is actually required for other purposes. The circumstances are different with reference to the manufacture of indigo as practised by the Badische Anilin und Soda Frabrik.

The process employed (Heumann's) uses, as its initial material, naphthaline, a product which is available in practically unlimited quantities. This body is oxidised by treatment with highly concentrated sulphuric acid in order to obtain phthalic acid. The next process is the conversion of the phthalic anhydride into anthranilic acid. This is combined with chlor-acetic acid and the condensation product, treated with caustic alkali, upon oxidation with the air yields indigo. The lecturer dwelt upon the invention and development of these various phases of the process. The experimental work was carried on for several years at the initiative and under the personal direction of Dr. Brunck. Though at the inception of the experimental work the Badische Anilin und Soda Fabrik were in possession of the best process known at the time for the production of phthalic anhydride, yet even this process did not yield that substance cheaply enough for use in the manufacture of indigo; and the new process, referred to above, for obtaining phthalic acid by oxidation with concentrated sulphuric acid in the presence of mercury salts was, therefore, devised by one of the chemists of the firm. This process, in which the sulphuric acid is reduced to sulphur dioxide, is dependent for its commercial success upon the possibility of cheaply regenerating the sulphur dioxide to obtain once more highly concentrated sulphuric acid. For this purpose the well-known catalytic process of the Badische Company is employed, the sulphur dioxide being combined with the oxygen of the air to yield sulphuric anhydride and so concentrated sulphuric acid. The importance of the manufacturing operations here referred to will most forcibly come home to many people from the information that in the manufacture of phthalic anhydride for the production of indigo in this way between 35,000 and 40,000 tons of sulphur dioxide are produced annually and reconverted into sulphuric anhydride and sulphuric acid. The Badische Company, with their entire output, now take rank as the largest manufacturers of sulphuric acid in the world. For the conversion of the phthalic anhydride into anthranilic acid, large quantities of chlorine are required, and chlorine is again needed for the production of the chlor-acetic acid, while for the melting operation to produce an indigo body a caustic alkali is requisite. The problem, therefore, is how to obtain this chlorine and caustic alkali most advantageously. For this purpose an electrolytic process has been adopted, but here there was the further difficulty that the chlorine obtained was not sufficiently pure. Hence another invention by a chemist of the firm was brought into play and the chlorine is purified by liquefaction, its manipulation being largely carried on in the liquid condition. After all these preliminary stages comes the actual manufacture of indigo by means of the Heumann process.

The lecture contained a description of the difficulties that had to be overcome in bringing the process at each step to perfection and in co-relating the various very different manufactures involved.

General Notes.

TEXTILE EXHIBITION, ROUEN, 1901.—The *Société Industrielle de Rouen* has arranged to hold an Exhibition of the Arts applied to the decoration of Textiles in the summer of 1901. The Exhibition will comprise four classes:—1. History of decoration of textiles; 2. Textiles decorated in 1901; 3. Textiles for colonial exportation; 4. Processes employed in the decoration of textiles.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov 19. Imperial Institute, South Kensington, S.W., 8½ p.m. Mr. James Stirling, "The Coal Resources of Victoria."

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. Sir Richard Jebb, "Macaulay."

Camera Club, Charing-cross-rd., W.C., 8½ p.m. Rev. F. C. Lambert, "Some Simple Optical Curiosities."

TUESDAY, Nov. 20...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on paper by Messrs. George Andrew Hobson and Henry Wragge, "The Metropolitan Terminus of the Great Central Railway." 2. Mr. Oscar Guttmann, "Machinery for the Manufacture of Smokeless Powder."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. T. A. Welton, "The Distribution of Population in England and Wales, and its Progress in the Period of Ninety Years, from 1801-1891."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Designers, Clifford's Inn, Fleet-street, E.C., 8 p.m. Mr. Philip Newman, "Design in the Future."

WEDNESDAY, Nov. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening Address of the 147th Session by Sir John Evans, Chairman of the Council.

Meteorological, 25, Great George-street, S.W., 7 p.m. 1. Mr. Richard H. Curtis, "Improved Mounting for the Lens and Bowl of the Campbell-Stokes Sunshine Recorder." 2. Mr. W. H. Dines, "Weekly Death Rate and Temperance Curves, 1890-1899." 3. Mr. Henry Millish, "Seasonal Rainfall of the British Islands."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. Exhibition of Slides illustrating the Structure of Shells.

Entomological, 11, Chandos-street, W., 7 p.m.

Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, Nov. 22...Royal, Burlington-house, W., 4½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Lord Harris, "The Presidency of Bombay."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. "Telegraphs and Telephones at the Paris Exhibition, 1900."

Camera Club, Charing-cross-rd., W.C., 8½ p.m. Mr. E. W. Brabrook, "Anthropology for Practical Men."

FRIDAY, Nov. 23... Junior Engineers, 9, Conduit-street, W., 8 p.m. Mr. A. T. Walmisley, "The Use of Rolled Joists in Construction."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Chemical Society's Rooms, Burlington-house, W., 5 p.m. 1. Prof. R. W. Wood, "The Anomalous Dispersion of Carbon." 2. Mr M. W. Travers, "The Liquefaction of Hydrogen." 3. Dr. E. H. Barton, "The Refraction of Sound by Wind."

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg leave to acknowledge, with thanks to the Proprietors, the receipt of the following Transactions of Societies and Periodicals.

TRANSACTIONS, &c.

American Academy of Arts and Sciences, Proceedings.
American Academy of Political and Social Science, Annals.
American Chemical Society, Journal.
American Institute of Electrical Engineers, Transactions.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Transactions and Proceedings.
Architectural Association, Notes.
Association of Engineering Societies (American), Journal.
Australasian Association for the Advancement of Science, Report.
Australasian Institution of Mining Engineers, Transactions.
Bath and West and Southern Counties Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Guiana, Royal Agricultural and Commercial Society, Journal.
British Horological Institute, Horological Journal.
Brussels, Revue du Travail.
———, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Cambridge Appointments Association, Gazette.
Camera Club, Journal.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Society of Civil Engineers, Transactions.
Central Chamber of Agriculture, Proceedings.
Chemical Society, Journal.
Chicago, Western Society of Engineers, Journal.
———, Field Columbian Museum, Publications.
Cleveland Institution of Engineers, Proceedings.
Cobden Club, Publications.
Cornell University, Physical Review.
East India Association, Journal.
Farmers' Club, Journal.
Franklin Institute, Journal.
Geneva, Société des Arts, Bulletin de la Classe d'Industrie et de Commerce.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Imperial Institute, Journal.
Incorporated Gas Institute, Transactions.
India, Geological Survey of, Memoirs, Records and Palæontologia Indica.
———, Government of, Agricultural Ledger.
Indian Meteorological Department, Report.
Institute of Bankers, Journal.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Electrical Engineers, Journal.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Junior Engineers, Record of Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Mining and Metallurgy, Transactions.
Institution of Naval Architects, Transactions.
Iron and Steel Institute, Journal.
Jamaica, Institute of, Journal.
Japan, College of Science, Imperial University, Journal.
Japan Society, Transactions and Proceedings.
Kew Gardens Bulletin.
Linnæan Society, Journal.
London Association for Protection of Trade, Monthly Report.
London Chamber of Commerce, Journal.
Lyons, Société d'Agriculture, Sciences et Industrie, Annales.
Manchester Literary and Philosophical Society, Memoirs and Proceedings.
Massachusetts Institute of Technology. Technology Quarterly and Proceedings of the Society of Arts.
Munich, Polytechnischer-Verein, Bayerisches Industrie-und-Gewerbeblatt.
National Association for the Promotion of Technical and Secondary Education. Record.
National Indian Association, "The Indian Magazine and Review."
Nederlandsche Maatschappij ter Bevordering van Nijverheid, Tijdschrift.
New South Wales, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Transactions.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions
Paris, Conservatoire National des Arts et Metiers, Annales.

Paris, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.
——, Société Internationale des Electriciens, Bulletin.
——, Société Nationale d'Acclimatation de France, Revue.
Patent Agents, Chartered Institute of, Transactions.
Patent-office, Illustrated Official Journal.
Pennsylvania (Western), Engineers' Society of, Proceedings.
Pharmaceutical Society, "The Pharmaceutical Journal."
Philadelphia, Academy of Natural Sciences, Proceedings.
———, Engineers' Club Proceedings.
Physical Society, Proceedings.
Quekett Microscopical Club, Journal.
Royal Agricultural Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Annual Report.
Royal Geographical Society, "The Geographical Journal."
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal.
Royal National Life Boat Institution, "The Life Boat."
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
Royal Statistical Society, Journal.
Royal United Service Institution, Journal.
Sanitary Institute, Journal.
Smithsonian Institution, Report and Publications.
Society of Antiquaries, Archæologia and Proceedings
Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Dyers aud Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South African Association of Engineers, Proceedings.
South Wales Institute of Engineers, Proceedings.
Victoria Institute, Journal of the Transactions.
Wisconsin Academy of Sciences, Arts, and Letters, Transactions.

PERIODICALS.

Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Athenæum.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
Building News.
Capitalist.
Chemical News.
Chemist and Druggist.
Chronique Industrielle.
Colliery Guardian.
Commerce.
Cosmos: Revue des Sciences.
Electrical Engineer.
Electrical Review.
Electrician.
Electricien (Paris).
Electricity.
Engineer.
Engineering.
Engineering News (New York).
Engineering Record (New York).
English Mechanic.
Gardeners' Chronicle.
Gardening World.
Herapath's Railway Journal.
Invention.
Iron and Coal Trades Review.
Ironmonger.
Journal of Gas Lighting.
Journal d'Hygiène.
Land and Water.
Leather Trades' Review.
Mechanical Engineer.
Medical Press and Circular.
Miller.
Millers' Gazette.
Mining Journal.
Moniteur Industriel.
Musical Standard.
Nature.
Oils, Colours, and Drysalteries.
Photographic News.
Photography.
Practical Engineer.
Produce Markets' Review.
Public Health Engineer.
Publishers' Circular.
Queen.
Revue Industrielle.
Sanitary Record.
School Board Chronicle.
Scientific American.
Shipping World.
Surveyor.
Textile Mercury.
Warehouseman and Draper.

Fortnightly.

Brewers' Guardian.
Corps Gras Industriels.

Country Brewers' Gazette.
Finance Chronicle.
Irish Builder.
Jeweller and Metalworker.
Moniteur des Produits Chimiques
Perak Government Gazette.
Quinzaine Coloniale.
Railways (Calcutta).
Revue des Cultures Coloniales.
Science and Art of Mining

Monthly.

American Exporter (New York).
Architectural Review.
Arms and Explosives.
Automotor.
Bookseller.
Brewers' Journal.
British Indian Commerce.
Building Societies' Gazette.
Cabinet Maker and Art Furnisher.
Canadian Patent Office Record.
Caterer and Refreshment Contractors' Gazette.
Coach Builders' and Wheelwrights' Art Journal.
Dyer and Calico Printer.
Educational Review.
Educational Times.
Engineering Magazine (New York).
Engineering Times.
Essex Review.
Feilden's Magazine.
Giornale del Genio Civile (Rome).
Indian and Eastern Engineer.
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Ingeniero Español.
Inventors' Review.
Irish Textile Journal.
Journal of Acetylene Gas Lighting.
Labour Co-partnership.
Machinery Market.
Marine Engineer.
Mercantile Guardian.
Metallographist (Boston, U.S.A.)
Mois Scientifique et Industriel.
Moniteur Scientifique.
Music.
Musical Times.
Oestereichische Monatsschrift für den Orient.
Paper Makers' Monthly Journal.
Philosophical Magazine.
Piano, Organ, and Music Trades Journal.
Plumber and Decorator.
Polytechnisches Centralblatt (Berlin).
Propriété Industrielle (Berne).
Railway Engineer.
Saddlers, Harness Makers, and Carriage Builders Gazette.
Science Abstracts.
Science Gossip.
Sugar Cane.
Symons's Monthly Meteorological Magazine.
Textile Manufacturer.
Textile Recorder.
Textile World (Boston).
Travel.
Tropical Agriculturist (Colombo).
Watchmaker, Jeweller, and Silversmith.
West Indian Bulletin.

NEWSPAPERS.

Banbury Advertiser.
Bombay Gazette (Overland Summary).
British Australasian.
Ceylon Observer (Overland Edition).
Daily Inter Ocean (Chicago).
Englishman (Calcutta).
Hindu (Madras).
Home and Colonial Mail.
London Commercial Record.
London and China Telegraph.
Madras Weekly Mail.
Newcastle Weekly Chronicle.
Nottinghamshire Guardian.
Pioneer Mail (Allahabad).
Shipping Gazette and Lloyd's List (Weekly Summary).
Straits Budget (Singapore).
Times of Ceylon (Weekly Summary).
Times of India (Overland Weekly Edition).

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